

How Interest Rates Changed under Financial Liberalization

A Cross-Country Review

Patrick Honohan

As financial liberalization progressed, the general level of real interest rates increased more in developing countries than it did in industrial countries. Volatility in wholesale interest rates also jumped, often markedly, in most liberalizing countries. Treasury bill rates and bank spreads showed the greatest increase in developing countries, shifting substantial rents from the public sector and from favored borrowers.



Summary findings

Financial liberalization was expected to make interest rates and asset prices more volatile, with distributional consequences such as reduced or relocated rents and increased competition in financial services. Honohan examines available data on money market and bank interest rates for evidence of whether these things happened.

He shows that as more and more countries liberalized, the level and dynamic behavior of developing-country interest rates converged to industrial-country norms. In the short term, volatility increased in both real and nominal money market interest rates. Treasury bill rates and bank spreads, evidently the most repressed, showed

the greatest increase as liberalization progressed — shifting substantial rents from the public sector and from favored borrowers.

Whereas quoted bank spreads in industrial countries contracted somewhat in the late 1990s, spreads in developing countries remained much higher, presumably reflecting both market power and the higher risks of lending in the developing world.

There was no clear-cut change in mean rates of inflation, monetary depth, or GDP growth. If anything, there was a small average improvement in inflation, but a decline in monetary depth and economic growth, relative to trends in industrial countries.

This paper — a product of Finance, Development Research Group — is part of a larger effort in the group to explore optimal policy under financial liberalization. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Agnes Yaptenco, room MC3-446, telephone 202-473-1823, fax 202-522-1155, email address ayaptenco@worldbank.org. Policy Research Working Papers are also posted on the Web at www.worldbank.org/research/workingpapers. The author may be contacted at phonohan@worldbank.org. April 2000. (48 pages)

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Introduction

The process of financial liberalization was expected to increase the volatility of interest rates and asset prices, to have distributional consequences in the form of reduced or relocated rents, and to have increased competition in the financial services industry. In this paper we examine the available data on money market and bank interest rates for evidence on these propositions.

We show that, as more and more countries liberalized, the level and dynamic behavior of developing country interest rates converged to industrial country norms. Liberalization did mean an increased short-term volatility in both real and nominal money market interest rates. Treasury bill rates and bank spreads were evidently the most repressed, and they showed the greatest increase as liberalization progressed: this shifted substantial rents from the public sector and from favored borrowers. Whereas quoted bank spreads in industrial countries contracted again somewhat during the late 1990s, spreads in developing countries remained much higher, presumably reflecting both market power and the higher risks of lending in the developing world.

Sections 1 and 2 review the global pattern of long-term and short-term dynamics in interest rate levels and spreads. Section 3 proposes an approach to judging when the *de facto* liberalization of wholesale rates occurred, and Section 4 measures the speed of adjustment of developing country interest rates to external interest rate shocks before and after these dates. Section 5 examines the way in which changes in wholesale rates passes through to bank lending and deposit rates. Using the date of *de facto* wholesale interest rate liberalization, Section 6 compares overall economic performance before and after. Section 7 contains concluding remarks.

1. Global trends in interest rate levels and spreads (annual data)

1.1 Global trends since 1960

Broad trends in global interest rates since 1960 are summarized by the world medians shown in Table 1.² There appears to have been a general upward trend in the level of world median real interest rates, but the most striking feature is a pronounced secular swing in real rates over the past forty years, with a sharp dip into negative rates in the 1970s followed by a recovery to higher than previous levels in the 1980s and 1990s, and the beginnings of a reduction again more recently. The swing is evident in both money market and deposit rates.

From a theoretical point of view, variations over time in the general level of unregulated wholesale *ex post* real interest rates can be explained by deviations of actual from expected inflation, and because of cyclical or trend changes in the productivity of capital and the propensity to save and perceptions of risk. Changes in the degree to which these interest rates are administratively controlled will also be a factor.

The causes of the secular swing in world interest rates since the 1960s, a well known feature of industrial country data, have been debated in the literature at length.³ Was there a downturn in the marginal efficiency of capital (possibly associated with the surge in petroleum and other primary product prices); or was there a transitory increase in the propensity to save? These are probably the leading explanations. In a fully integrated world capital market, these real factors would be fully transmitted across all markets, and would not retain any national features. Nominal, currency-specific factors such as shifts in the relation between actual and expected inflation are of greater interest in the present context, where we are looking at differences in the behavior of interest rates from country to country. Thus, a fairly plausible and

² In this section, unless otherwise stated, "real" rate data shown are computed as *ex post* real interest rates simply adjusted for consumer price inflation, see the data appendix. In Table 1, for each year the median is formed from all of the countries for which *IFS* data exists for that year.

³ An important early analysis of the episode is Blanchard and Summers (1984). Bank of England (1996) presents a useful overview of empirical work explaining long-trends in real interest rates in the industrial countries.

parsimonious (albeit somewhat underrated) interpretation attributes part of the U-shaped evolution to a long lag in the formation of inflation expectations. In this account the relatively high inflation of the 1970s in most industrial countries was unexpected and its persistence continued to be underestimated for most of that decade.⁴ Furthermore, even where the market did revise its inflation expectations upwards, interest rate controls inhibited the response of some markets to the expected inflation. In contrast, although inflation began to come under control in most industrial countries by the mid-1980s, by that time inflation expectations were high and remained stubbornly so, placing upward pressure on nominal market interest rates. By that stage, many interest rate controls had been dismantled, so that actual rates more closely reflected market forces. A subsequent decline in real rates by the mid-1990s is explained in this account by the gradual decline in inflation expectations in recent years. In addition to these effects of the "great inflation" of the 1970s, the stance of countercyclical monetary policy has also been a factor.

The degree to which developing country rates have tracked the long swing is an indication of the degree to which elements of global financial integration were already in effect by 1960.

Table 1: *Median World Real Interest Rates, 1960-95*

	Money market	Deposit rate	Lending less deposit
1960	1.3	2.4	3.6
1965	-0.5	0.5	3.5
1970	-0.7	0.8	2.9
1975	-5.8	-3.5	3.5
1980	-6.1	0.0	3.7
1985	2.0	5.0	4.2
1990	0.4	5.1	5.5
1995	2.2	3.4	5.9

Note: In this table deflation is by current inflation, i.e. these are *ex ante* real rates with stationary expectations.

⁴ That is not to say that inflation was underestimated in each quarter, but investing in inflation hedges was inhibited by set-up costs, as well as liquidity and other risks, the assumption of which could only be justified by expectation of sustained inflation.

The median quoted intermediation spread between deposit and lending rates remained broadly constant during 1960-1980 but has risen rather sharply since then. A number of interpretations are possible. For one thing there could have been an increase in the market power of banks, possibly associated with the relaxation of interest rate controls. Another factor could be the deterioration in loan-loss experience in the latter part of the sample: equilibrium spreads should have widened to take account of the credit risk. Finally, the degree to which the quoted rates are representative will have varied over time, with large depositors and first-rate borrowers beginning to have new non-bank opportunities.

1.2 The developing countries catch up: annual data from 1975

Data for the early years in Table 1 are sparse: the early years included very few observations. Only from about 1980 on is there data for at least several dozen countries in each case. Table 2 and Figures 1 to 4 provide more detail for the period since 1975, distinguishing between industrial and developing countries. These show mean and percentile figures in addition to the median on an annual basis. Along with money market and treasury bill rates, we show bank deposit rates and the quoted intermediation spread, i.e. the difference between quoted deposit rates and quoted lending rates for as many countries as have sufficient annual observations included in *International Financial Statistics*.⁵ The general trend is summarized by three-yearly averages of the medians shown in Table 2.

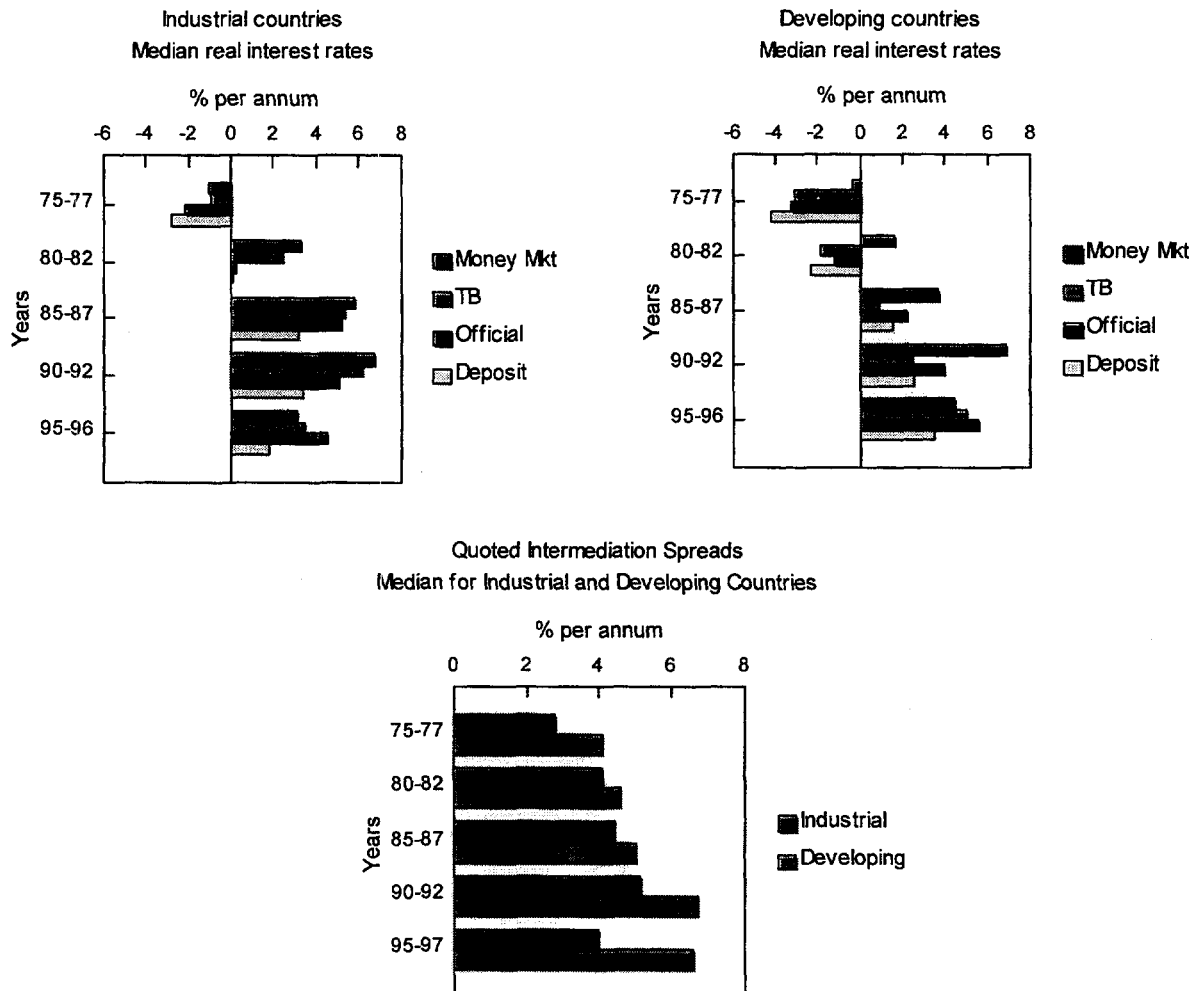
Table 2: *Median Ex-post Real World Interest Rates: 1970s to 1990s*

%	Money Market		Treasury Bill		Deposit		Lending less deposit	
	Industrial	Developing	Industrial	Developing	Industrial	Developing	Industrial	Developing
1975-77	-1.0	-0.4	-0.9	-3.1	-2.8	-4.2	2.8	4.1
1980-82	3.3	1.6	2.4	-1.9	0.1	-2.3	4.1	4.6
1985-87	5.8	3.7	5.3	0.9	3.2	1.5	4.4	5.0
1990-92	6.7	6.8	6.2	2.5	3.3	2.5	5.1	6.7
1995-96	3.1	4.4	3.5	5.0	1.8	3.5	4.0	6.6

Note: The mean of the median across countries is shown. For the spread mean shown is for 1995-97.

⁵ These figures and data are based on countries for which annual data is available for at least 12 years within 1980-93. It is not a balanced pool: the number of countries varies somewhat from year to year, but more according to the series, from a mean of 35 for money market and 36 for treasury bill rates to 59 for intermediation spreads and 62 for deposit rates. This sample selection strategy represents a compromise between the desirability of including as many countries as possible with the risks of too unbalanced a pool. One potentially important but hidden source of sample-selection bias could arise to the extent that reporting of data to *IFS* is correlated with a liberalized interest rate regime.

Figure 1: *Median Ex-post Real World Interest Rates: 1970s to 1990s*



This annual data reveals some similarities and some contrasts between developing and industrial country interest rates.

- *Developing country real interest rates on an upward trend*

The real interest rates shown begin at predominantly negative levels, with even the third quartile generally negative or close to zero in the late 1970s. Developing country rates were, on average, even lower than those in industrial countries up to the mid-1980s; but thereafter developing country rates increased and passed out the industrial countries to end the period

higher. The reduction in industrial country rates from the mid-1990s was not systematically followed in the developing world

Market re-ranks different interest rates

Market forces can be expected to push deposit rates below, and lending rates above, wholesale money market rates, reflecting costs and risks. Assuming that quoted interbank money market rates relate to lending that is highly liquid and virtually free of credit risk, Treasury bill rates at the same maturity should be very close to money market rates. In the data, median⁶ deposit rates were generally lower than money market rates, but not always lower than Treasury bill rates. Until the 1990s, Treasury bill rates fell below money market rates in developing countries, probably reflecting controls, taxes or other administrative requirements (including compulsory take-up rules) more than a market assessment of differential risk. The fact that official (discount) rates switch from being lower than money market rates to being higher may reflect changing mechanisms of central bank liquidity support to the market as more central banks shifted away from a subsidized and rationed facility to a penalty rate facility as their main off-market method of intervening.

International dispersion of real interest rates does not fall

Evidence on trends in the international dispersion of real interest rates is ambiguous. All standard measures of dispersion increase from the 1960s to the 1970s, though the small number of countries included in the early years may affect this. Subsequently the interquartile range and the gap between top and bottom decile show no clear trend in any of the series,⁷ but the standard deviation and range increase, reflecting more extreme outliers.⁸ This finding is, perhaps, slightly surprising: had the data been drawn from countries with and without interest controls we might have expected an increase in dispersion in the 1980s when real interest rates increased in the

⁶ Note that in general a different country will be the median for each rate.

⁷ For example, the estimated LS time trend for the interquartile range of money market rates is -6.5 basis points per annum – small relative to a mean range of 462 basis points – with a standard error of 3.3, not quite significant at the 5 per cent level. The steepest shrinkage of interquartile is for the deposit rate, with an estimated annual trends of -12.6 basis points, highly significant with a standard error of 4.3. (Note in contrast that the interquartile range for the intermediation spread does show a statistically significant widening over time.)

⁸ Especially negative outliers - in several years the distribution across countries has a highly negative skew.

uncontrolled countries, followed by a narrowing as more and more countries decontrolled. This alerts us to the possibility that interest rate controls may not have been fully effective in the early years, at least for these countries. Bear in mind, however, that the sample of countries may suffer from selection bias to the extent that reporting of statistics to *IFS* may be correlated with degree of regime liberalization.

Bank spreads increase

Bank quoted gross intermediation spreads (as measured by subtracting quoted deposit from quoted lending rates) increase sharply with the general increase in rates during the 1980s. In industrial countries the increase is from 2.8 per cent in the mid-1970s to 5.2 per cent in the early 1990s; in the developing countries the spreads are wider: increasing from 4.1 per cent to 6.7 per cent. During the 1990s, these spreads remain high in developing countries, whereas they decline in the industrial countries.⁹ Except for one year, the median quoted rates for the developing countries are higher than for the industrial countries. The gap becomes quite wide by the late 1990s. Once again, this result cannot be extrapolated to an increase in bank profitability for a variety of reasons. For one thing, the single rates used do not purport to be average rates, but quoted rates for instruments of standard quality. Furthermore, the risk profile of borrowers and the extent to which quoted rates bundle the cost of other banking services to customers may have changed systematically over time.

2. Short-run dynamics of wholesale rates - overview

We have nearly complete monthly data since 1980 on wholesale¹⁰ interest rates and inflation for some 28 significant¹¹ developing countries. In a later section we will have something to say about nominal rates, but here the focus is on rates adjusted for exchange rate

⁹ To what extent this recent reversal in industrial countries reflects disintermediation from banking is not clear: it is widely believed that industrial country banks have lost some market power in the past decade, which would have narrowed spreads. But although it is their most creditworthy customers that they have lost to securities markets, the shifting composition of their loan portfolio towards lower quality is unlikely to influence the *quoted* spreads, which are usually for standard borrower categories.

¹⁰ We use the term to imply either money market or treasury bill rates.

¹¹ The number would be 43 before excluding microstates and multiple members of currency unions (see Data Annex)

change and expected inflation. We find that both forms of adjusted exchange rates have displayed extremes of high and low - both spikes and on a sustained basis.

2.1 Expected or ex ante real interest rates in developing countries

Our approximation for expected, or *ex ante* real exchange rates, is to subtract a smoothed rate of inflation (Hodrick-Prescott filter - see Data Annex) from actual nominal rates. This simple procedure has the advantage of eliminating the volatile month-to-month noise in the inflation data.¹² Because of the high smoothing parameter used, short-run changes in the real interest series thus derived are largely attributable to interest rate changes rather than expected inflation (and this is true of all spikes).

The resulting data are plotted in Figure 5. The plots are characterized by gentle fluctuations with a period of a few years punctuated by intervals of sometimes violent fluctuations on a month-to-month basis.¹³ So, in contrast to what is predicted by simple models of market efficiency, rational expectations and static preferences, real interest rates in developing countries have had a considerable degree of persistence, as well being subject to short term reversible shocks.

Developing country interest rates have been high Some of these countries have experienced extended periods of very high real interest rates. Of the 17 treasury bill countries in our data set, eight have had mean real interest rates in double digits continuously for at least three years. Guyana had the highest three-year mean real interest rate at over 26 per cent. Much higher real interest rates have been sustained for periods as long as one year: five of the countries had one-year means of over 20 per cent: one (Sierra Leone) with 45 per cent and another (Mexico) with 33 per cent.

¹² We applied a single filter to each country's entire inflation series, rather than using a Kalman filter. A one-sided backward-looking univariate filter on this data would use too little information to provide a credible expectations proxy, especially (but not only) for early periods. This outweighs the obvious drawback of the procedure we have adopted, namely that the expected inflation for time t is computed using data that was not available at time t . While that would make this approximation questionable for examining issues of informational efficiency, those issues are not a central focus of this paper (cf. Baxter, 1996; Edison and Pauls, 1993).

...And volatile But there have also been very low real interest rate observations in developing countries, and, despite a low (negative) mean value, the mean of 25 developing country monthly standard deviations (excluding Argentina and Brazil) in our sample is 877 basis points, compared with just 187 basis points for the eight control industrial countries. And this is not just due to some outliers: the smallest of developing country standard deviations is 221 basis point for Singapore.

2.2 Negatively skewed distribution of \$-adjusted rates

Volatility and extreme values are also evident in Table 3, which compares the 1980-97 average statistics of monthly wholesale returns for developing and industrial countries adjusted for actual change in exchange rates against the US dollar. Although the mean of developing country \$-adjusted money market rates was on average much lower than for industrial countries, this mainly reflected the wider variation over time of exchange-rate adjusted interest rates for developing countries, and in particular the negative skewness (influence of extreme negative observations). In other words, occasional sharp devaluations were not fully compensated-for by a sufficient excess return or peso premia in developing country interest rates in normal times.

Table 3: *Ex post \$-adjusted Money Market Rates: Industrial and Developing Countries, Monthly Data: 1980-97*

<i>% per annum</i>	26 Developing Countries	12 Industrial Countries
<i>mean over countries of:</i>		
mean (standard error)	0.49 (9.0)	7.34 (1.1)
median	3.04	7.56
maximum	107.3	86.2
minimum	-490	-94.9
standard deviation	53.3	28.9
skewness	-3.95	-0.1
<i>median over countries of:</i>		
median	6.95	6.11
standard deviation	35.2	32.5

Note: 26 large developing countries not including Argentina or Brazil

¹³ Unit root tests can reject non-stationarity of at least half of the country series at the 5 per cent level, suggesting that these apparent slow oscillations are not just an optical illusion.

3. The timing of liberalization: wholesale rates

For the purpose of describing liberalization, we need at least to distinguish between three main types of control: first, external capital (exchange) controls which drive a wedge between domestic and foreign wholesale rates but need not involve any administrative control of domestic rates. Second, administrative control of domestic wholesale rates (this is unlikely to be very effective in the absence of exchange controls). Third, control of retail bank deposit and lending rates. Note that even in a liberalized environment, the authorities can also influence wholesale interest rates by use of monetary policy instruments, but such action is to be distinguished from "control".

Because relaxation of these three controls is rarely simultaneous, it is not normally possible to define a single date on which liberalization occurred. Worse, multiplicity of different interest rates in any country and the varied array of administrative controls¹⁴ that have been employed make it impossible in most cases to define a single liberalization date even for one of the three types of control. Besides, not infrequently, there have been partial reversals of prior liberalizations.¹⁵ Finally, all observers concur that the timing in practice of particular relaxations often does not coincide with the formal relaxation: sometimes the control has become a dead letter long before formally removed; in other instances formal control has been replaced by informal administrative suasion, or *de facto* control exercised by the government through its ownership of dominant banks.

By the mid-1990s the process of liberalization has proceeded in many countries to full or almost full abolition of all three types of control; but the process has been a protracted one with many stages varying in importance. This clearly points to the need for detailed country-by-

¹⁴ For example, foreign exchange controls may be relaxed for certain classes of investors; or ceilings on capital exports may be increased. Controls on treasury bill rates may be retained, along with compulsory investment requirements from banks and other institutions, while other wholesale rates are freed. Controls on lending rates may be relaxed for certain sectors of borrowers, or for certain categories of bank or near-bank. Controls on bank deposit rates may be relaxed for certain size categories, or maturities, or for accounts attracting a particular class of income tax treatment.

country analysis.¹⁶ But it is also an obstacle to econometric estimation of the impact of liberalization on a cross-country basis, as knowledge of the timing is all but indispensable.

An alternative is to try to infer the timing of key aspects of liberalization from the statistical properties of the interest rate data themselves.¹⁷ Two classic approaches to measuring the degree of external capital account liberalization by the looking at interest rate and other macroeconomic time series have been proposed by Edwards (1985) and Edwards and Khan (1985), where interest rate data is available, and by Haque and Montiel (1991) where interest rate data is not available. Each of these approaches assumes that the effective interest rate is a weighted average of that which would prevail in fully controlled and uncontrolled regimes respectively; the estimated weight then becomes an indicator variable representing the *degree* to which the domestic money market is open and uncontrolled. They could be adapted to allow some time-variation in the indicator, and hence in principle to identify a liberalization date. While both approaches thus offer elegant solutions to the problem at hand, they have the important shortcoming that each assumes that uncovered interest parity UIP prevails in an uncontrolled market. The well-known fact, that UIP is empirically questionable even for countries without any form of foreign exchange control, mars the use of this as an identifying assumption. There are also difficulties with the specification of equilibrium in the controlled market. Further commentary on these approaches, together with some discussion of possible alternatives, is included as Appendix 1.

A simpler approach that does not rely on UIP depends instead on the assumption that the short-run dynamic behavior of interest rates changes with liberalization.

¹⁵ Thus it is not surprising to find, for example, that a recent study's table presenting just 27 liberalization dates had to be accompanied by two-and-a-half pages of qualifying notes (Galbis, 1993).

¹⁶ As illustrated by several contributions to the present research (Cho, 1999; Montes-Negret and Landa, 1999; Wyplosz, 1999).

¹⁷ If an unregulated curb market exists alongside the formal market, and if interest rate data for the curb market exist, then differences between the rates can be used as a measure of the degree to which the controls bite. This approach has been used for domestic curb markets by Reisen and Yechès (1993), and extensively for off-shore "euro"-markets, cf. Wyplosz (1999).

A For administratively controlled interest rates this assumption seems readily acceptable. If rates that were held absolutely constant for extended periods are suddenly found to change from month to month, there has to be a presumption that controls have been relaxed. We find below that simple filters designed to detect shifts of this type from administratively fixed rates to variable identify plausible regime shift dates for many developing country bank nominal wholesale rates.

B Where rates are market-determined but behind effective exchange controls, they are exposed to fluctuations in money supply, but may be partly insulated from the pressures of speculation related to changing exchange rate expectations. (A simple model is discussed in Appendix 1). If the second form of disturbance is likely to be higher than the first, liberalization of capital controls will be marked by an increase in short-run interest rate volatility. This assumption is necessarily controversial. However, a sharp increase in short-run wholesale interest rate volatility during the period known to be one of liberalization may then indicate a critical effective date of liberalization. We will see below that a filter of this type based on recursive residuals of a simple dynamic model of wholesale interest rate unambiguously identifies regime shift dates for many developing countries, plausibly marking significant shifts towards elimination of capital controls.

Regime shift of type A: Relaxation of nominal rate controls

Figure 6 shows changes in nominal money market rates. Several countries begin the period with a pattern of occasional non-zero changes only, and then make a transition into frequent changes. To identify key dates for relaxation (or reimposition) of fixed rate administrative control we applied a filter which triggers "control off" whenever the number of changes in the following seven months is four or more, and subsequently triggers "control on" if there is a period of more than 12 months without any change. "Control off" periods are identified as such in Table 4.

Regime shift of type B: Marked increases in real interest volatility

In order to identify shifts of this type, we estimated an econometric model of each country's *ex ante* real interest rate and looked for large forecast errors. Specifically, we fitted a simple error-correction model for each country's real interest rate, assuming that it could be modeled as a function of changes in the world interest rate,¹⁸ of the gap between the world and the local interest rate, and by some autoregressive dynamics.¹⁹ The estimates were by recursive least squares, and we tested the fitted equations for break-points indicated by systematic failure of one-month ahead recursive forecasts.²⁰ Examples of the procedure are shown in Figures 7 (a) and (b) for India and Kenya. The recursive residuals from the dynamic interest rate model are shown, bracketed by 5 per cent confidence intervals. In the lower panel is plotted the probability level at which the hypothesis of no structural change can be rejected in each period. For the Indian data, March 1990 is identified as the break point, and for Kenya, March 1993. Plots for all the countries, together with details of the estimated regressions on the full period, and on the before- and after-liberalization sub-periods are provided in Appendix 2. Note that this method cannot detect a gradual increase in volatility.

As the method identifies regime change events with short-term increases in volatility, the subsequent finding that volatility remained high after the change is not an inevitable and tautological consequence of the identification method, but represents an independent observation. (Indeed, to verify this, we also computed post-event volatility removing a six-month window after the event.)

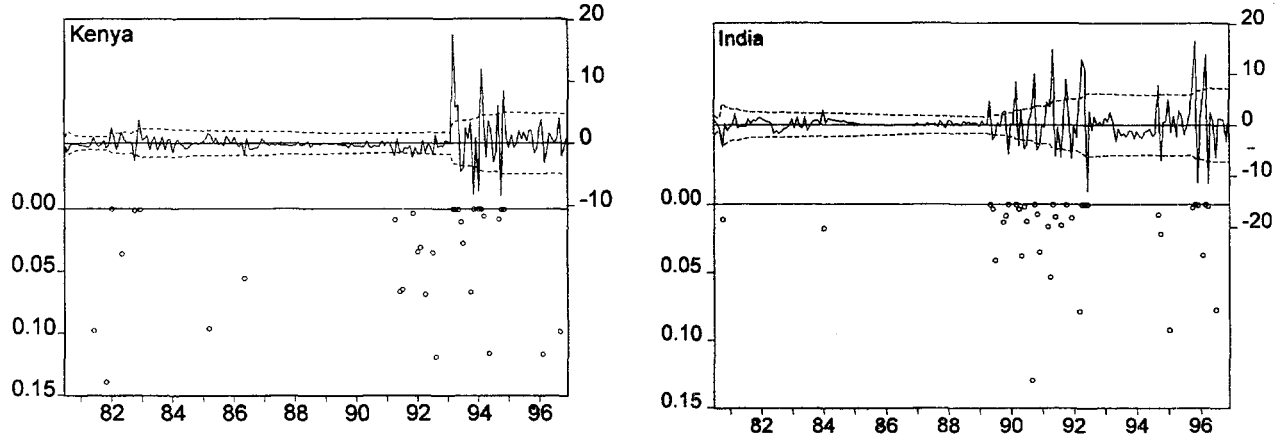
¹⁸ We used the first principal component of the 8 large industrial country real TB rates as a proxy for the world rate.

¹⁹ The model employed is equivalent to that of equation (1') in the next section below, with $k=1$.

²⁰ The criterion for a break was three forecast errors in four consecutive months each statistically significant at least the 1 per cent level. (A single data outlier in the level of interest rates could have triggered a break if the criterion had required only two significant forecast errors).

Figure 7: *Recursive residuals from dynamic model of real interest change*

(a) Kenya; (b) India



Repeating the exercise for all of the countries we found a plausible pattern of breaks (Table 4). For 15 of the 17 developing country TB rates, there was a single break during the sample period²¹. Following the break, the residual standard error was much higher - the median ratio of the before and after residual standard errors was 4.3.²² Thus we find not only an episode of increased volatility as estimated by the recursive prediction failure, but also that subsequent volatility is higher on a sustained basis.

The filter flags sudden increases in volatility, but, based as it is on recursive (backward-looking) regressions, it does not imply a sustained increase in volatility after the liberalization date. Our finding that volatility did stay high after the liberalization date does therefore represent an independent finding.

²¹ Two breaks for Trinidad & Tobago.

²² The calculation was also made after deleting six observations at the break in order to verify that the increase in variance was persistent and not solely driven by a few months around the date of the break.

The coefficients of the error-correction process are not all well-determined, but sometimes there is also an indication of a stronger impact of world interest rates after the break. All in all, the empirical patterns detected seem to confirm the *a priori* belief that this method would capture a significant date in the liberalization of wholesale interest rates.²³

The same approach was extended to 8 of the 10 money market rates (Argentina and Brazil excluded because of the difficulty of defining a satisfactory smoothed inflation series). Here a further three break points were detected as shown in Table 4, again with high volatility ratios. The indications were that most of the remaining countries may have crossed that threshold before 1980.²⁴

Also included in Table 4 are the liberalization dates provided for these countries by other recent studies.²⁵ The differences between the dates reflect differences in the concept of liberalization date being used. They should thus be considered as complementary to the dates obtained by approaches (a) and (b) here. Galbis (1993) study uses dates at which preferential lending rates, or controls on key bank deposit or lending rates were removed. Demirgüç-Kunt and Detragiache (1998) use deregulation of bank interest rates as the observable policy change to date liberalization. Williamson and Mahar (1998) are looking at a wider concept of financial liberalization and provide two dates: 'start of liberalization' and 'largely liberalized'.

²³ We also carried out the same exercise for the thirteen industrial countries. Break points within the sample period were also found for four of these. (An unusual situation arose for one country, Ireland, where a break existed, but the post-break residual variance was lower than the pre-break. In fact the identified break was in this instance related to the EMS crisis of 1992-93 rather than to liberalization.)

²⁴ Liberalization is not irreversible; the data from Malaysia (late 1981), and to a lesser extent India (early 1984) and Pakistan (late 1985) provides some indications of a reversal to a narrower range of fluctuation.

²⁵ Appendix Table A gives the dates from these studies for additional developing countries.

Table 4: *Date of de facto liberalization of wholesale interest rates*

<i>Approach:</i>	"Control off"	Marked volatility increase 1980-97		Expert datings			
	Date <i>A</i>	Date <i>B</i>	Volatility ratio	Galbis	D&D	W&M	
						Start	Largely
<i>60C Treasury Bill</i>							
Fiji	82:08	85:06	4.7				
Ghana	84:08-84:11; 87:10	91:10	2.1				
Guyana	87:03-88:07; 89:10	89:10	5.5		91		
Jamaica	80:08	91:03	4.3	85:10	91		
Kenya	pre-80	93:03	4.2		91		
Sri Lanka	85:09	88:03	1.6		80	78	-
Mexico	pre-80	83:11	2.6	85:03	89	74; 89	92
Malawi	92:06	92:06	5.3				
Nepal	89:08	89:10	32.5	86:05		89	-
Philippines	pre-80	84:06	3.8	82:12	81	81	94
Papua New Guinea	80:07	86:01	1.1		pre-80		
Swaziland	82:12	None					
Trinidad and Tobago	80:02	84:07; 94:11	6.7				
Sierra Leone	91:12	87:08	4.9				
Uganda	92:03	81:10	135.0	88:07			
South Africa	pre-80	None				80	84
Zimbabwe	pre-80	92:04	2.4				
<i>60B Money market</i>							
India	pre-80	90:03	4.6		91	92	-
Korea	pre-80	None		Not lib	84-88; 91	83	-
Malaysia	pre-80	None		78:10	pre-80	78	92
Pakistan	pre-80-86:12; 89:12	92:03	3.7				
Singapore	pre-80	None				78	73
Thailand	pre-80	90:03	2.1	90:03	89	mid-80s	92
Cote d'Ivoire	82:07-90:05	None		89:10			
Mauritius	85:02	None		81:11			
<i>Industrial countries</i>							
Australia	pre-80	82:02	2.3		81		
New Zealand	85:02	83:08	7.9		pre-80; 84		
Spain	84:01	83:01	21.3	87:03			
Portugal	83:01	82:06	90.5		94		

Notes: Industrial countries included are those for which regime changes (b) were identified post 1980.

Volatility ratio is the ratio of the standard error of estimate of dynamic regression model in the post-liberalization period to that in the pre-liberalization period.

Dates from other studies: Galbis (1993); D&D=Demirgüç-Kunt and Detragiache (1998); W&M: Williamson and Mahar (1998) - showing start of liberalization and 'largely liberalized' dates.

4 Convergence of interest rates

What does liberalization mean for global integration of world financial markets? Some indication can be found by modelling the dynamic behavior of real interest rates. We arrive at two main conclusions.

First, real *ex ante* wholesale interest rates in developing countries are quite strongly influenced by world real interest rate movements. Furthermore, if we distinguish between before- and after- the liberalization events (type *B*) reported in Table 4,²⁶ we find that the impact of world interest rates and the speed of convergence both increase following liberalization.

Second, nominal wholesale interest rates help predict subsequent exchange rate movements to a larger extent than is the case in the industrial countries. Following liberalization, their predictive power is no better than before.

The textbook model of an efficient and frictionless expectations-driven financial market without risk aversion (and with sufficient goods-market integration to ensure purchasing-power parity) implies that real interest rates will be equalized across countries and that nominal interest rates differentials will represent unbiased predictions of inflation and exchange rate change. Imperfectly integrated and partially efficient financial markets will still tend to be influenced by world interest rates and by expectations, though perhaps partially and with a lag. This section provides a quantification of the imperfection, and how it evolves with liberalization.

4.1 Dynamic error-correction model

For our real *ex ante* wholesale interest rates, we estimated a dynamic error-correction model in which the change in the interest rate is influenced by current world interest rates changes, and by the lagged gap between domestic and world (real) interest rates, together, perhaps with the lagged dependent variable.

²⁶ In respect of the countries for which no liberalization events of type *B* are detected, we treat the wholesale rates as liberalized throughout the sample

Thus, if the real world interest rate at time t is denoted r_t^w and the real interest rate for country i is denoted r_t^i then the convergence model can be written:

$$\Delta r_t^i = a_i + b_i \Delta r_t^w + c_i (r_{t-1}^w - r_{t-1}^i) + d \Delta r_{t-1}^i + u_t^i \quad (1)$$

or,

$$\Delta r_t^i = a_i + b_i \Delta r_t^w + c_i (r_{t-1}^w - r_{t-1}^i) + u_t^i \quad (1')$$

with (in 1') $u_t^i = \sum_{j=1}^k \rho_j u_{t-j}^i + \varepsilon_t$.

Here the coefficient a_i indicates an average deviation between country i 's real interest rate and that of the "world", b_i measures the impact effect of a change in world interest rates on those in i and the "catch-up effect" c_i indicates the speed with which deviations from the mean relationship with the world interest rate are closed. Provided $d < 1$ (or that the autoregressive dynamics of the residual are stable), a positive value of c_i implies that the impact of any transitory shock Δr_t^w or ε_t on r_t^i is eventually completely damped.²⁷ The coefficient d , or the autocorrelation coefficient ρ capture the remainder of the dynamics. (Equation (1') is also the model used in Approach (b) above to identify a liberalization date.)

For a country whose financial system has not been liberalized and integrated into the world economy, one would expect smaller values of b and c , together with possibly larger values of a . (Indeed, if the domestic financial system was not at all linked to the rest of the world, even indirectly, the coefficients b and c would be zero.)

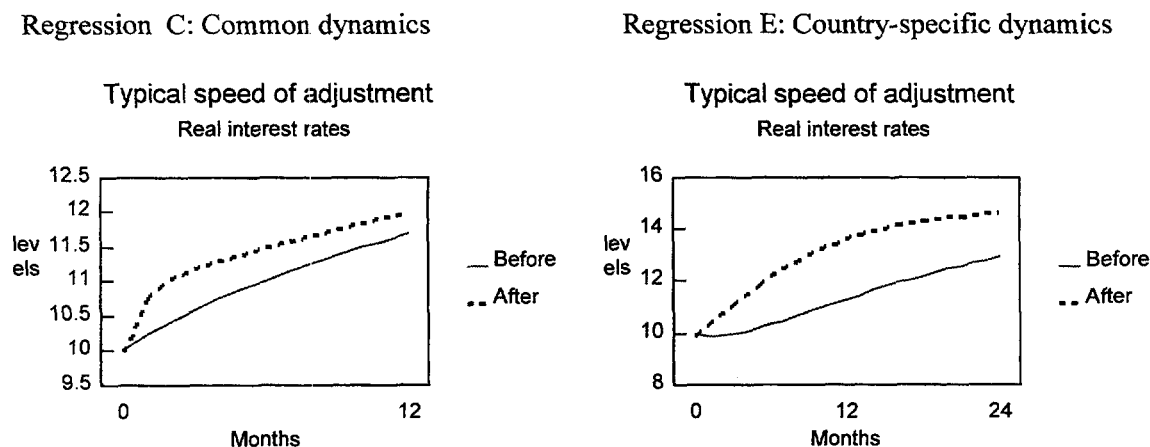
Pooled cross section-time series estimation was employed. Although the restriction that coefficients were the same across countries (i.e. for all i) could be statistically rejected, it was discovered that the rejection was at lower levels of significance if the autoregressive coefficients were unrestricted, while the impact of world rates was restricted. The point estimates obtained from such a model indicate that, even before the identified dates of liberalization, world interest

²⁷ Note that a statistical test here requires cointegration techniques, on which a large literature exists, cf. Wu and Zhang (1996), O'Connell (1998).

rates did have an impact on developing countries. The point estimate of the catch-up term is estimated to be twice as high after liberalization than before. Table 5 provides a representative selection of estimates.²⁸

The typical speed of adjustment of these developing country interest rates to a shock in world interest rates is also estimated to be faster after liberalization. Assuming common dynamics, but allowing different responses before and after liberalization (as in Regression C of Table 5) results in a pattern as shown in the left hand panel²⁹ of Figure 8 for a 500 basis point rise. While the impact effect in the first few quarters is much different, the subsequent adjustment to the new equilibrium is slow in both (though the precision of the estimate of long-term adjustment is naturally weak). Inclusion of long (18 month) autoregressive disturbance dynamics (right hand panel of Figure 8, based on the Regression E of Table 5) accentuates the difference between before and after. (The figures show point estimates; 95% confidence intervals do overlap).

Figure 8: *Speed of adjustment of developing country real interest rates before and after liberalization.*



²⁸ Accepted zero restrictions on common parameters are imposed. Although the restriction that country coefficients are common is not accepted, we report country-specific coefficients only for the variable that gives the largest increase in log-likelihood.

²⁹ Using point estimates.

4.2 Interest differentials as predictors of exchange rate change.

A topic of extensive previous research for industrial countries is the degree to which uncovered interest parity prevails. Most research shown that it does not,³⁰ using some variant of a regression of the exchange rate change (Δe) on interest differentials, i.e.:

$$\Delta e_{t+1} = f + g(r_t^i - r_t^{us}) + u_t \quad (3)$$

and finding that the intercept f is nonzero and the slope g not unity.

Although subtle econometric issues arise, a simple pooled regression on monthly data for twelve industrial countries in our sample (differentials against the US dollar) is not out of line with standard findings: The estimated intercept at 3.4 per cent is significantly different from zero, the estimated slope is -0.21 (wrong sign) and significantly different from plus unity. (Also the autoregressive parameter is significantly different from zero, contrary to the uncovered parity and rational expectations hypothesis). The same pooled regression for 25 developing countries has an even larger intercept, but now the slope is positive at 0.59, though it is still significantly different from unity. (Table 6).

Because of the empirical failure of this theory for industrial countries, and the absence of an accepted theory to explain this,³¹ it would be unwise to draw strong conclusions from the fact that developing country interest rates are correlated with subsequent exchange rate movements. A plausible interpretation is that future exchange rate change in high inflation developing

³⁰ But weaker tests of the theory can hold: deviations from UIP are generally found to be stationary and may have mean insignificantly different from zero. See Tanner (1998), whose decomposition of UIP deviations highlights the relatively more important role in developing countries of inflation and real interest rate fluctuations. However, in our data (which excludes Argentina and Brazil), a zero global mean of UIP deviations is strongly rejected (i.e. in the cross-section time-series pool).

³¹ Most of the explanations advanced invoke some form of expectations formation error or lag, perhaps combined with an activist monetary policy which makes the interest differential endogenous. (Froot and Frankel, 1990, Evans and Lewis, 1991; Kaminsky 1993; McCallum, 1994). There are also acute small sample econometric problems (Marshall et al, 1997).

countries contains a more predictable component which is absent from exchange rate change in the industrial countries over this time period.³²

Interestingly, the inclusion of post-liberalization dummies did not improve the fit of these interest parity regressions.

Levine (1991) found for five industrial countries that forecast changes in the real exchange rate $(\Delta q = \Delta e_{t+1} - \pi_t^i + \pi_t^{us})_t$ were also a best forecast of deviations $(uip = \Delta e_{t+1} - r_t^i + r_t^{us})_t$ from UIP, pointing to an dominant role of anticipated real exchange rate fluctuations in causing the failure of UIP. This result does not appear to carry over to the pool of developing countries. Although forecast values of Δq do help forecast uip , these forecasts can be improved upon.

³² This meshes with the finding of Mishkin (1992) that the Fisher effect applies only where there is a stochastic trend inflation

Table 5: *Estimate of dynamic model of wholesale interest rate convergence – Equations (1), (1')*

	<i>A Constrained</i>		<i>B Country-specific dynamics</i>		<i>C Effect of Liberalization</i>		<i>D Common dynamics</i>		<i>D' Liberalization changes dynamics</i>		<i>E Country-specific autocorrelation</i>	
	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)
<i>a</i>	0.079	(8.3)	0.042	(6.1)	0.046	(6.5)	0.040	(3.3)	0.044	(5.9)	0.054	(3.9)
<i>b</i>	0.135	(3.3)	0.071	(3.0)							-0.014	(5.4)
<i>c</i>	0.017	(10.4)	0.011	(9.0)	0.008	(5.5)	0.009	(4.6)	0.007	(5.0)	0.010	(3.9)
<i>d</i>	0.320	(24.6)	country		country		0.683	(28.5)			0.759	(17.1)
<i>dum*a</i>							0.063	(3.5)			0.141	(5.4)
<i>dum*b</i>					0.102	(2.9)	0.148	(2.8)	0.093	(2.5)	0.077	(3.1)
<i>dum*c</i>					0.009	(4.1)	0.011	(3.8)	0.008	(3.7)	0.035	(5.8)
<i>dum*d</i>							-0.449	(16.5)	-0.207	(6.5)	-0.211	(6.2)
Sample	26 developing 80:03-96:12		26 developing 80:03-96:12		26 developing 80:03-96:12		26 developing 80:03-96:12		26 developing 80:03-96:12		26 developing 80:03-96:12	
Method	SUR		SUR		SUR		SUR		SUR		SUR; 18 th order auto	
RSQ/DW	0.097	2.06	0.157	2.02	0.161	2.03	0.103	2.03	0.164	2.03	0.332	1.98

Note: 'Country' means country-specific coefficients estimated (not reported);

Method: SUR is Seemingly unrelated regressions system estimate of pool coefficients; 'auto'=autocorrelation.

Table 6: *Uncovered Interest Parity*
Dependent variable: log-change in US\$ exchange rate– Equation 3

	<i>A Industrial Countries</i>		<i>B Developing Countries</i>	
	Estimate	(t-stat)	Estimate	(t-stat)
<i>f</i>	3.43	(3.2)	9.96	(6.1)
<i>g</i>	-0.22	(1.1)	0.59	(5.9)
<i>ρ</i>	0.34	(18.5)	0.20	(3.0)
Sample	12 industrial 80:01-97:12		25 developing 80:01-97:12	
Method	Pooled LS		Pooled LS	
RSQ/DW	0.097	2.06	0.157	2.02

Note: St. Lucia omitted: no variation in *e*.

The models of Edwards and Khan and Haque and Montiel, discussed earlier and in Appendix 1, rely on the idea that the domestic interest rate is a weighted average of the rate that would prevail if UIP was valid and a rate determined by domestic considerations. Refining that idea, as suggested in Appendix 1, we calculated the predicted exchange rate change on the basis of available data for each country for each data, and use that prediction as an explanatory variable in a regression of the interest rate. The domestic explanatory variables should not enter separately in the equation. Interestingly, we found that the coefficient on the predicted exchange rate change was insignificantly different from zero for pre-liberalization periods, but highly significant, and with a coefficient of about 0.37 for post-liberalization. However, though free of some other problems that arise with that literature, this approach has the drawback of relying on the UIP framework.

5. Dynamic behavior of bank rates and intermediation spreads

Severely repressed financial systems often display inversions of interest rate structures, with bank lending rates, at least for some categories of borrower, being controlled below the wholesale rates that might otherwise be considered as representing the marginal cost of funds. This is not the case in the countries with sub-annual data which we have been considering in the previous sections. Instead, we find that bank interest rates in these countries do respond to movements in wholesale rates quite quickly. Typically, deposit rates respond first, with the

result that an increase in rates widens intermediation spreads at first. Spreads then narrow, as lending rates gradually adjust, but the catch-up is estimated to be incomplete, so that a positive long-term equilibrium relationship is estimated to exist between intermediation spreads and the level of interest rates.

Here again our main approach was to use a simple error-correction formulation in a pooled cross-section and time series. As indicated in the appendix there are more countries for which sufficient bank rate data exist than is the case for wholesale rates. An error-correction model explaining movements in lending rates by those in deposit rates in 32 countries estimated on quarterly data 1980-97 suggests a rapid pass-through: over 81 per cent of any change in deposit rates being picked-up in lending rates in the same quarter, and over 93 per cent by the second quarter. However, such a relationship can hardly be considered causal, as both bank rates are likely to be influenced by the same exogenous factors.

Instead, therefore we modeled the determination of both deposit and lending rates as being jointly influenced by wholesale rates, using the model:

$$\Delta r_t^l = a^l + \sum_{j=1}^k b_j^l \Delta r_{t-j+1}^m + c^l (r_{t-1}^l - r_{t-1}^m) + d^l (r_{t-1}^p - r_{t-1}^l) + u_t^l \quad (2)$$

$$\Delta r_t^p = a^p + \sum_{j=1}^k b_j^p \Delta r_{t-j+1}^m + c^p (r_{t-1}^p - r_{t-1}^m) + d^l (r_{t-1}^l - r_{t-1}^p) + u_t^p \quad (2')$$

where superscripts l , m , and p denote deposit, wholesale and lending rates respectively. (Country identifier has been suppressed.)

Table 7: *Estimate of dynamic model of bank interest rate convergence – Equations (2), (2'), (3)*

	<i>A Deposit rate Developing (2)</i>		<i>B Deposit rate Industrial (2)</i>		<i>C Deposit rate (2) Country dynamics</i>		<i>D Lending rate Developing (2')</i>		<i>E Lending-Deposit Spread (3)</i>	
	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)
<i>a</i>	0.018	(0.5)	-0.081	(2.9)	-0.044	(1.9)	0.254	(5.5)	country	
<i>b₁</i>	0.361	(30.7)	0.402	(33.3)	country		0.361	(29.2)	0.0318	(6.2)
<i>b₂</i>	0.140	(10.4)	0.086	(7.4)	0.079	(9.7)	0.104	(8.0)	country	
<i>b₃</i>	0.027	(24.6)	0.037	(3.3)	0.019	(2.5)	0.028	(2.2)		
<i>c</i>	-0.006	(1.0)	-0.010	(1.7)	0.002	(0.4)	-0.033	(3.5)	0.095	(10.1)
<i>d</i>	-0.042	(4.6)	-0.049	(6.5)	-0.031	(4.3)	-0.013	(1.6)	0.216	(12.8)
Sample	21 developing 80:Q4-98:Q2		19 industrial 80:Q4-98:Q2		21 developing 80:Q4-98:Q2		21 developing 80:Q4-98:Q2		21 developing 80:Q2-98:Q2	
Method	SUR		SUR		SUR		SUR		SUR - AR(1) spec	
RSQ/DW	0.530	1.96	0.451	2.09	0.660	1.84	0.481	2.03	0.241	1.96

Note: Dependent variables are first differences in the interest rates and spread as indicated;

'Country' means country-specific coefficients estimated (not reported except for Regression C - Table 8);

Method: SUR is Seemingly unrelated regressions system estimate of pool coefficients;

'AR(1) spec' means country specific first order autocorrelation coefficient estimated.

Table 7a: *Estimate of dynamic model of bank interest rate convergence – Equations (2), (2'), (3)*

	<i>A Deposit rate Developing (2)</i>		<i>C Deposit rate (2) Country dynamics</i>		<i>D Lending rate Developing (2')</i>		<i>E Lending-Deposit Spread (3)</i>	
	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)
<i>a</i>	-0.069	(1.7)	-0.078	(3.0)	0.109	(3.1)	country	
<i>b₁</i>	0.504	(16.3)	country		0.246	(9.5)	0.024	(2.8)
<i>b₂</i>	0.040	(1.2)	0.045	(2.1)	0.036	(1.3)	country	
<i>b₃</i>	0.034	(1.0)	0.003	(0.1)	0.068	(2.4)		
<i>c</i>	0.007	(1.0)			-0.024	(2.0)	0.088	(6.6)
<i>d</i>	-0.056	(3.8)	-0.068	(5.3)	0.011	(1.1)	0.216	(10.7)
<i>dum*a</i>	0.094	(1.3)	0.031	(0.1)	0.298	(4.0)	0.578	(3.1)
<i>dum*b₁</i>	-0.154	(4.7)	-0.063	(2.0)	0.144	(5.0)	0.099	(2.9)
<i>dum*b₂</i>	0.111	(3.1)	0.028	(1.2)	0.061	(2.0)		
<i>dum*b₃</i>	-0.012	(0.3)	0.040	(1.7)	-0.052	(1.7)	-0.0001	(0.0)
<i>dum*c</i>	-0.023	(1.8)			-0.004	(0.2)	0.004	(0.2)
<i>dum*d</i>	0.010	(0.5)	0.042	(2.9)	-0.056	(3.5)	0.050	(2.6)
Sample	21 developing 80:Q4-98:Q2		21 developing 80:Q4-98:Q2		21 developing 80:Q4-98:Q2		21 developing 80:Q2-98:Q2	
Method	SUR		SUR		SUR		SUR - AR(1) spec	
RSQ/DW	0.530	1.96	0.780	1.98	0.489	2.01	0.252	2.00

Note: Dependent variables are first differences in the interest rates and spread as indicated;

'Country' means country-specific coefficients estimated;

Method: SUR is Seemingly unrelated regressions system estimate of pool coefficients;

'AR(1) spec' means country specific first order autocorrelation coefficient estimated.

Estimating these equations in a pooled cross-section and time series with 21 developing countries and 19 industrial countries shows that the speed of adjustment is quite similar for deposit rates as between developing and industrial countries (Regressions A and B of Table 7). Relaxation of the constraint that the catch-up coefficient c^l is the same for all of the developing countries provides a very substantial improvement in fit. (Regression C of Table 7). The estimated contemporaneous response of the deposit interest rate to wholesale rates from this equation varies widely from between about 75 and 85 per cent for Guyana and four African countries (Mauritius, Morocco, Uganda and Zimbabwe) to only 4 per cent for Fiji (Table 8), suggesting a ranking of the degree to which these countries have a competitive and unrestricted banking market.

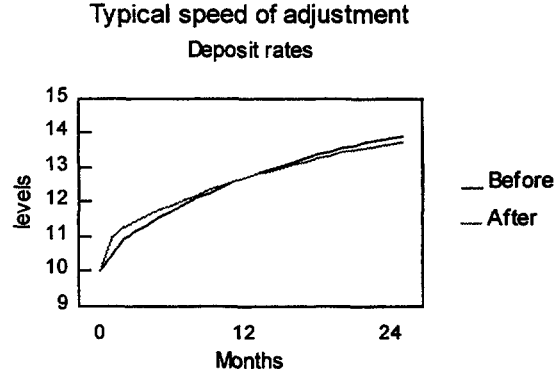
Table 8: *Estimated Catch-up Term (from Regression C of Table 7)*

	c^l (t-statistic)			c^l (t-statistic)	
Fiji	0.041	(2.9)	Philippines	0.527	(14.0)
Sri Lanka	0.082	(6.2)	St. Lucia	0.551	(0.6)
Indonesia	0.124	(3.5)	Papua NG	0.552	(10.6)
Cote d'Ivoire	0.181	(3.0)	South Africa	0.618	(10.6)
Sierra Leone	0.191	(3.6)	Zimbabwe	0.745	(11.9)
Trinidad	0.264	(1.6)	Mauritius	0.760	(8.2)
Korea	0.374	(5.7)	Uganda	0.775	(12.8)
Malawi	0.452	(7.5)	Swaziland	0.788	(9.5)
Zambia	0.458	(20.1)	Morocco	0.800	(16.1)
Jamaica	0.492	(11.6)	Guyana	0.863	(23.4)
Singapore	0.506	(10.4)			

Adjustment of the lending rate p follows a somewhat similar pattern, though it appears that gradual adjustment to any deviation from the mean gap that has opened up between deposit and lending rates takes place through adjustment in the lending rate rather than the deposit rate. Thus the deposit rate can be seen as a faster-adjusting variable than the lending rate (Regression D of Table 7).

The impact of liberalization is indicated by the second panel of Table 7, which contains estimates in which the parameters are allowed to shift with the liberalization (dates as before, augmented by the Appendix Table where necessary). Although the parameter values change, there is little overall impact on the speed of adjustment, as illustrated in Figure 9 (based on Regressions A of Table 7).

Figure 9: *Speed of adjustment of developing country deposit interest rates before and after liberalization.*



Dynamics of the spread

The dynamic pattern of movements in the intermediation spread is summarized by a similar error-correction equation, with the change in the spread as dependent variable:

$$\Delta r_t^p - \Delta r_t^l = a^s + b_1^s r_t^m + b_2^s \Delta r_t^m + c^s (r_{t-1}^p - r_{t-1}^m) + d^s (r_{t-1}^l - r_{t-1}^p) + u_t^s \quad (3)$$

(Regression E of Table 7). This reveals that the spread does widen in response to an increase in money market rates, converging gradually to an equilibrium relationship, and that the equilibrium spread is positively related to the general level of interest rates, as indicated by the significant coefficient on the lagged wholesale rate (equivalent results are obtained when the deposit rate is substituted for the wholesale rate). Inclusion of liberalization dummies suggests that the long-term equilibrium relation between spread and level of rates is primarily a post-liberalization phenomenon.

6. Economic Performance Before and After Liberalization

How did aggregate economic performance change following liberalization? Of course a full causal analysis of the impact of liberalization goes well beyond the before and after experiment, and requires controlling for many other factors. Nevertheless, it is worth reporting the results of a simple before-and-after comparison, using the dates from Approach (b) above. The comparison does not reveal a clearcut change in mean rates of inflation, monetary depth or GDP growth. If anything there is a small average improvement in inflation, but a disimprovement in monetary depth and economic growth, relative to industrial country trends. Table 9 shows mean pre- and post-liberalization mean values of these variables for the set of countries for which liberalization dates for the Treasury Bill rate have been identified above. The data are also shown normalized as the difference between the subject countries and the mean for seven large industrial countries taken as a control group. Inflation—much higher than in the control group fell somewhat more after liberalization, but the difference of 1.4 per cent is not statistically significant. The modest increase in monetary depth (liquidity ratio and in annual GNP growth is in both cases less than occurred simultaneously in the control group, though again the difference is insignificant.

Table 9: *Macroeconomic performance before and after interest liberalization*

	Before	After	Before	After	Difference	Better ?
	Liberalization		(relative control group)		(t-stat)	
Inflation (CPI growth %)	27.7	21.8	+19.9	+18.5	-1.4 (0.2)	Yes
Liquidity ratio (M2/GDP %)	35.3	37.0	-23.9	-27.2	-3.4 (0.5)	No
GNP growth (%)	2.3	2.6	+0.6	+0.2	-0.4 (0.6)	No

Note: Source: *International Financial Statistics*. Annual data 1975-97. The liquidity ratio takes the ratio of end-year M2 to the mean GDP of same and following year. 19 liberalizing countries including Portugal as in Table 1. Control group: US, UK, Germany, Italy, Sweden, Switzerland and Canada. Date of liberalization is that method B above.

The increase in interest rates and their volatility have not been the only factor influencing economic development over the past two decades. Furthermore, financial liberalization has normally been a complex, long-drawn out, and sometimes reversed process. It would be surprising if a before and after comparison based on our single date (method B) were to show a significant impact.³³

7. Concluding remarks

Even an analysis confined to the countries for which data is available provides unmistakable evidence for an increase in the general level of real interest rates as financial liberalization progressed, and that this increase was more pronounced than the contemporaneous increase in industrial country rates. The volatility in wholesale rates also jumped in most liberalizing countries, the regime change in this respect often being quite marked.

Though evidence of an increase in global integration of interest rates is also noted, the indications here are more muted than might have been expected, probably reflecting the fact that pressures of globalization often persisted through the pre-liberalization period, and were certainly present before 1980.

As well as the implicit redistributions associated with changes in the level of wholesale rates, changes in the relative position of different interest rates also have had a distributional effect, as well as an effect on incentives. The increase in Treasury bill rates closer to other wholesale rates is one important aspect here, as is the widening of bank interest spreads, and the tendency for such spreads to be correlated in the long-run with the level of wholesale rates.

³³ The econometrics of these issues are addressed in the context of financial development and growth by King and Levine (1993a,b), Levine, Loayza and Beck (1998), cf. Nausser and Kugler (1998).

Appendix Table: *Liberalization dates*

(as reported in various studies)

<i>Method:</i>	Statistical (wholesale rates)		Galbis	Expert datings		W&M
	"Control off" (a)	Volatility increase (b)		D&D	Start	Largel y
Argentina			77:06		77; 87	82; 93
Australia	pre-80	82:02		81		
Bangladesh					89	—
Bolivia			85:08			
Brazil			75:03		89	—
Cameroon			90:10			
Chile			75:04	pre-80	74	85
Colombia			80:01	pre-80	80	95
Costa Rica			86:08			
Cote d'Ivoire	82:07-90:05	—	89:10			
Ecuador				86-87; 92		
Egypt				91	91	—
El Salvador				91		
Fiji	82:08	85:06				
Ghana	84:08-84:11; 87:10	91:10				
Guatemala				89		
Guyana	87:03-88:07; 89:10	89:10		91		
Honduras				90		
Hong Kong					78	73
Hungary			91:01			
India	pre-80	90:03		91	92	—
Indonesia				83	83	89
Israel				90	87	91
Jamaica	80:08	91:03	85:10	91		
Jordan				88		
Kenya	pre-80	93:03		91		
Korea	pre-80	—	Not lib	84-88; 91	83	—
Malawi	92:06	92:06				
Malaysia	pre-80	—	78:10	pre-80	78	92
Mauritius	85:02	—	81:11			
Mexico	pre-80	83:11	85:03	89	74; 89	92
Morocco					91	96
Nepal	89:08	89:10	86:05		89	—
New Zealand	85:02	83:08		pre-80; 84		
Nigeria			87:07	90		

Pakistan		pre-80	92:03				
Papua Guinea	New	80:07	86:01		pre-80		
Paraguay					90		
Peru						91	93
Philippines		pre-80	84:06	82:12	81	81	94
Poland				90:01			
Portugal		83:01	82:06		94		
Romania				91:04			
Sierra Leone		91:12	87:08				
Singapore		pre-80	—			78	73
South Africa		pre-80	—			80	84
Spain		84:01	83:01	87:03			
Sri Lanka		85:09	88:03		80	78	—
Swaziland		82:12	—				
Taiwan						89	—
Tanzania				91:07	93		
Thailand		pre-80	90:03	90:03	89	mid-80s	92
Togo					93		
Trinidad and Tobago	and	80:02	84:07; 94:11				
Turkey				80:07; 87:07	80-82; 84	80; 88	90
Uganda		92:03	81:10	88:07			
Uruguay				79:09	pre-80		
Venezuela				81:08; 89:02	89	91	—
Zaire					pre-80		
Zambia					92		
Zimbabwe		pre-80	92:04				
Venezuela				81:08; 89:02	89	91	—
Zaire					pre-80		
Zambia					92		

Note: Other studies (based on expert assessments of administrative changes: Galbis (1983), Demirgüç-Kunt and Detragiache (1998), Williamson and Mahar (1998) - start of liberalization and 'largely liberalized' dates (see text).

Figure 2: *Real Ex-post Wholesale Rates (IFS 60B)*

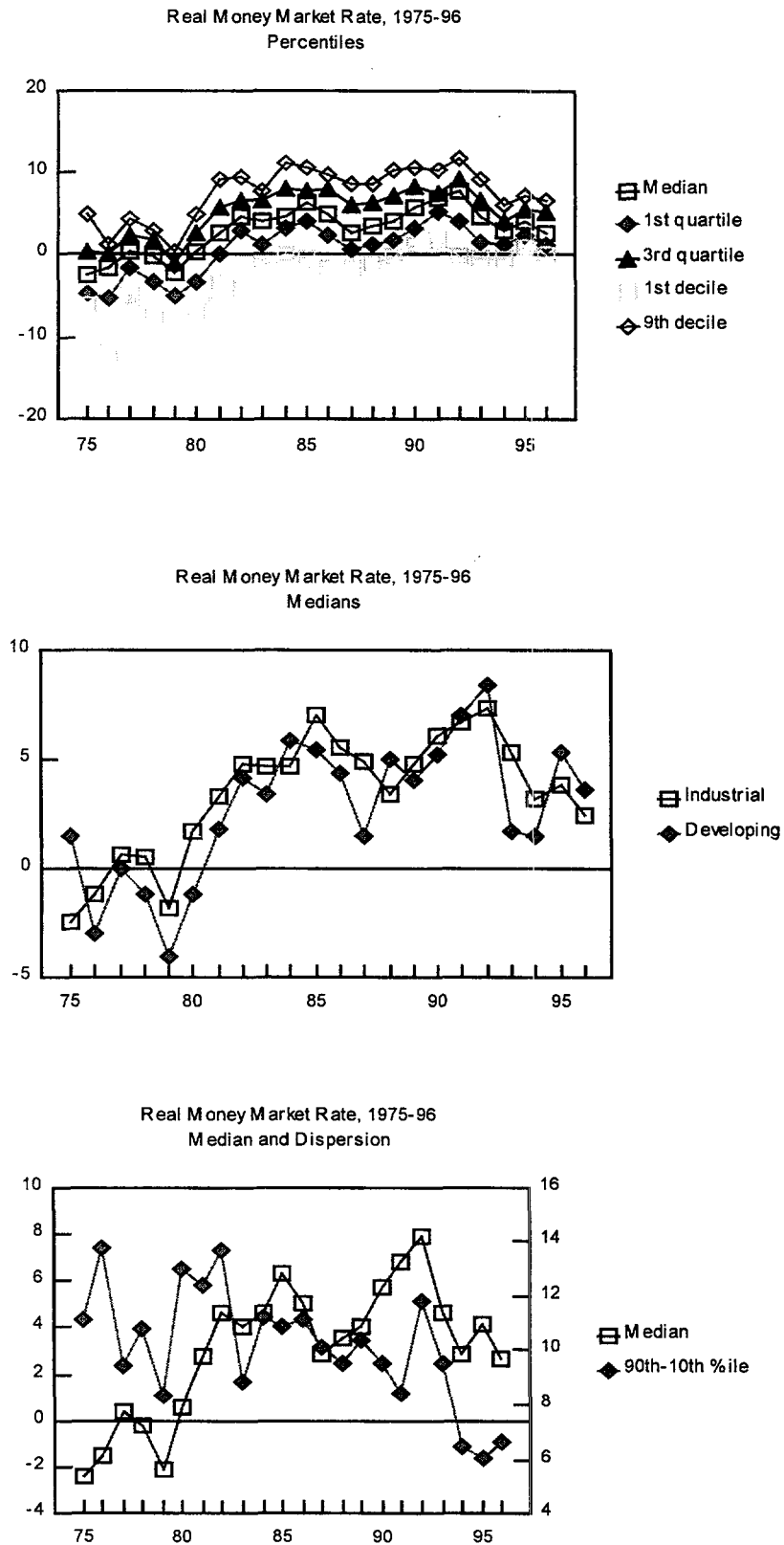


Figure 3: *Real Ex-post Deposit Rates (IFS 60L)*

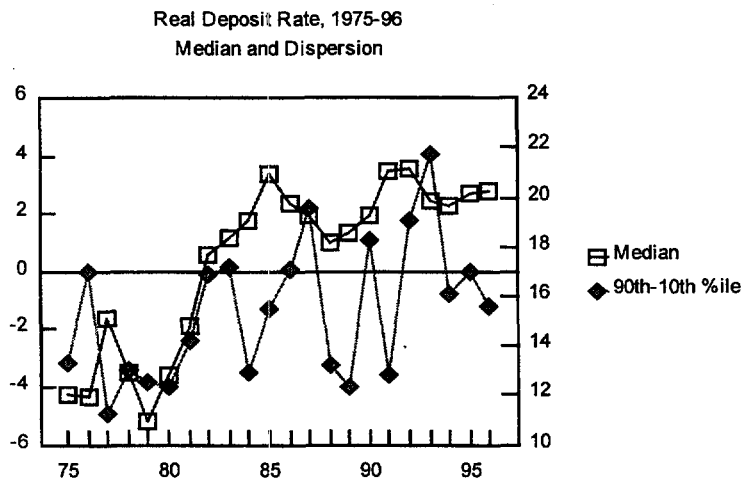
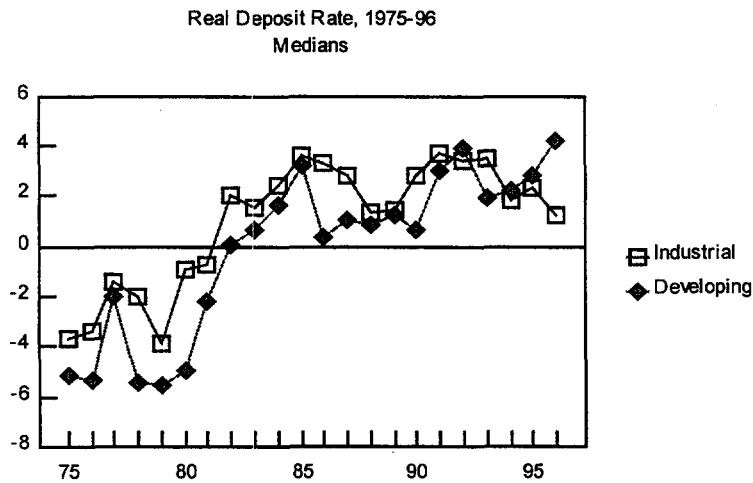
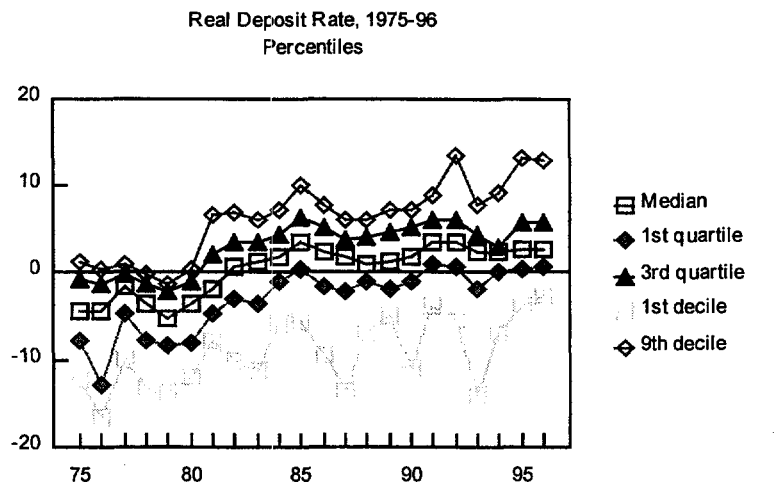


Figure 4: *Quoted Intermediation Spreads (IFS 60P-60L)*

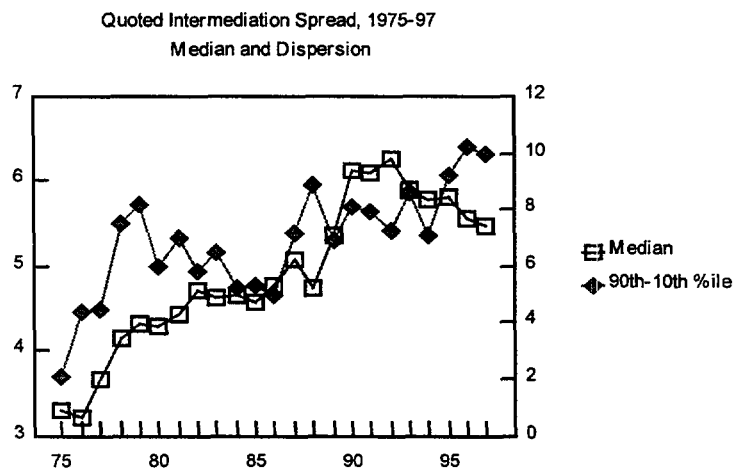
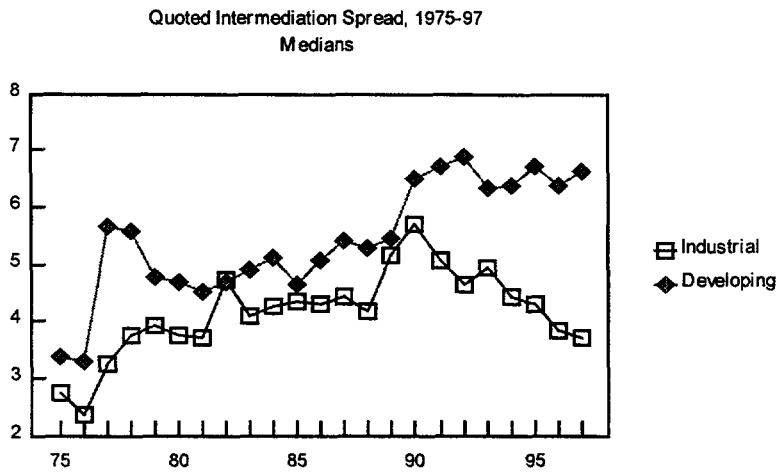
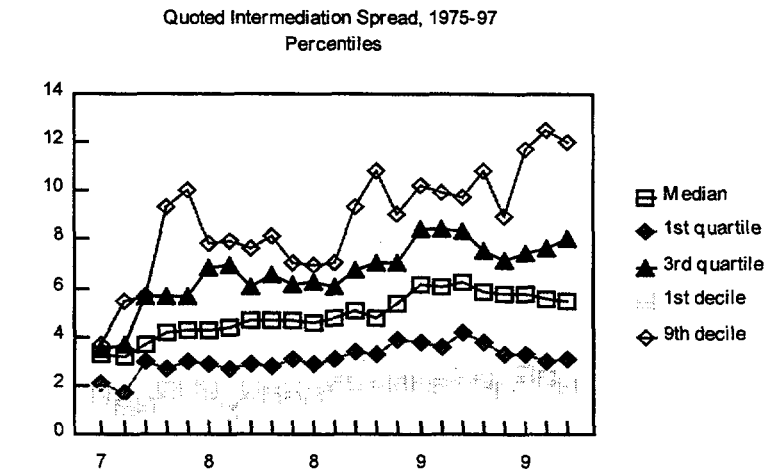


Figure 5: *Real Ex-ante Interest Rates*

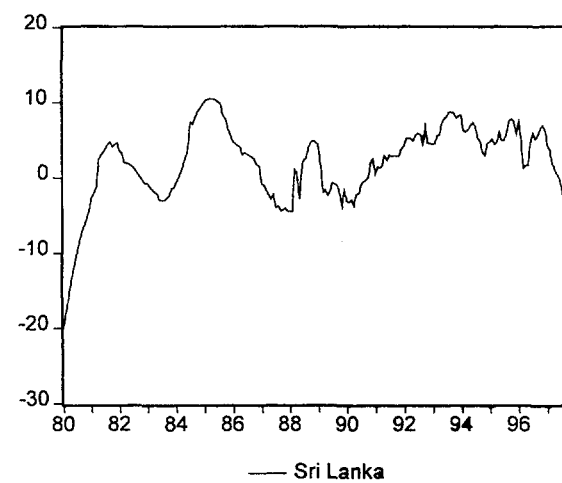
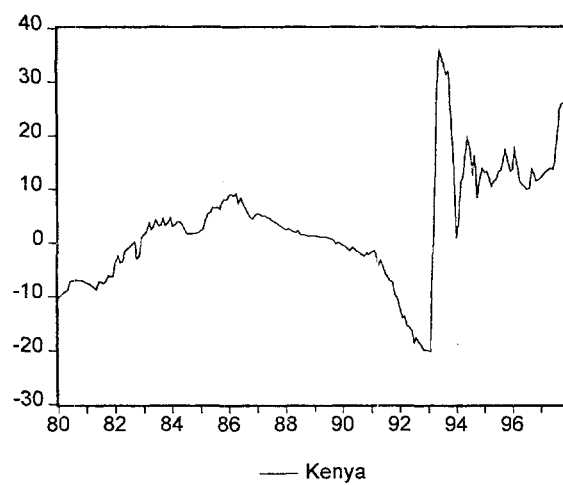
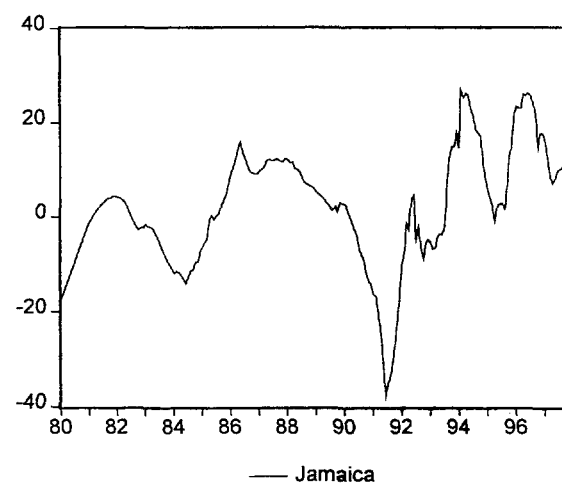
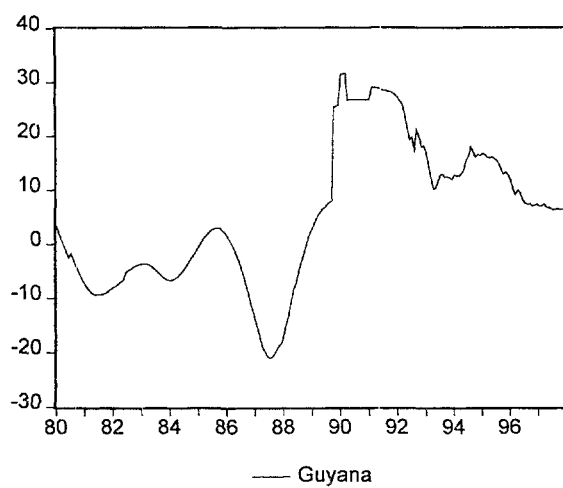
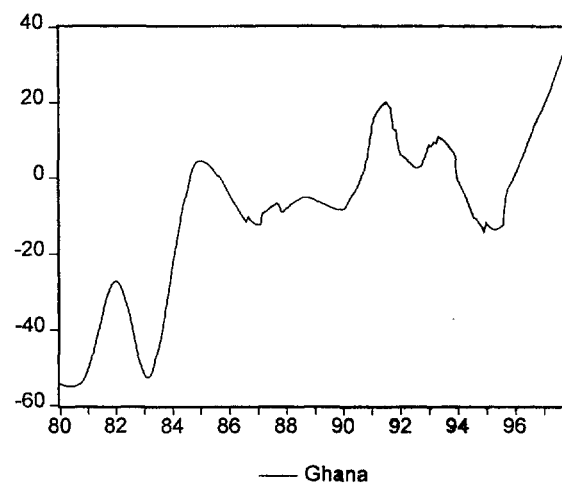
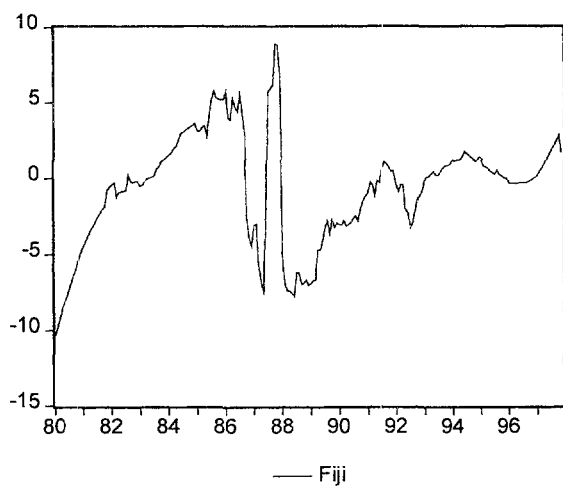


Figure 5: *Real Ex-ante Interest Rates* (contd.)

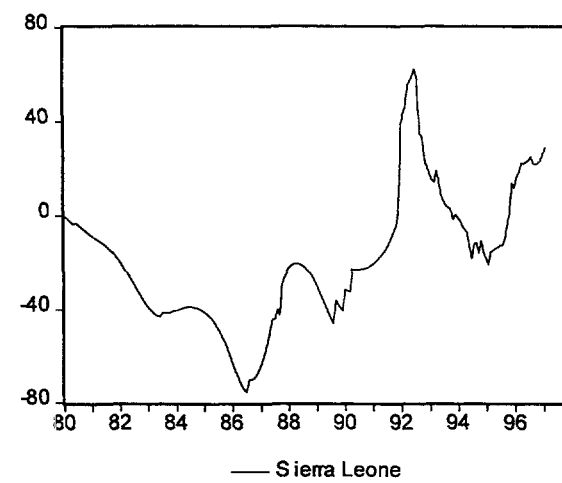
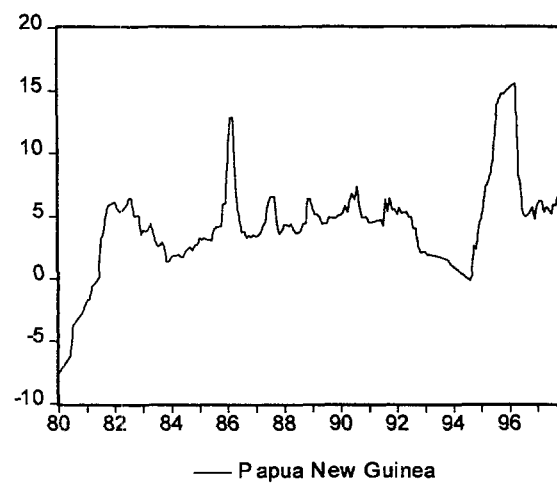
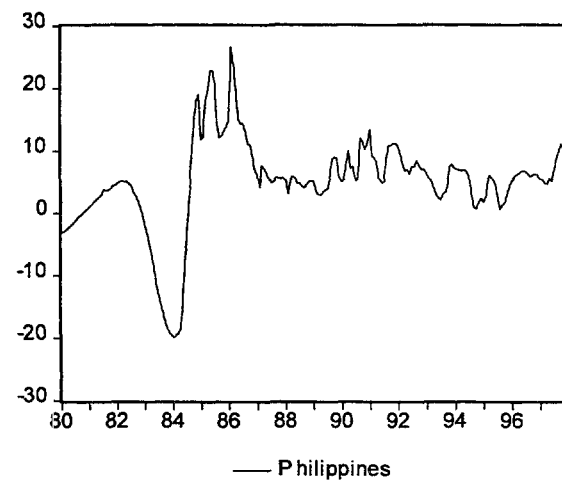
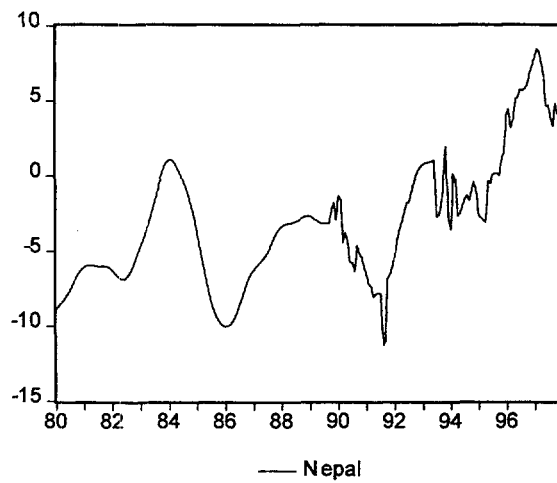
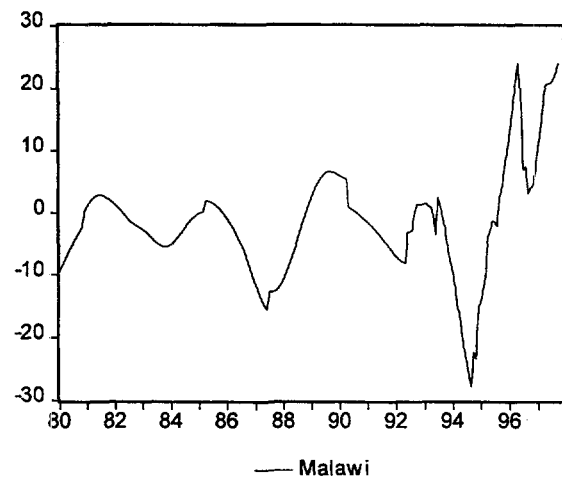
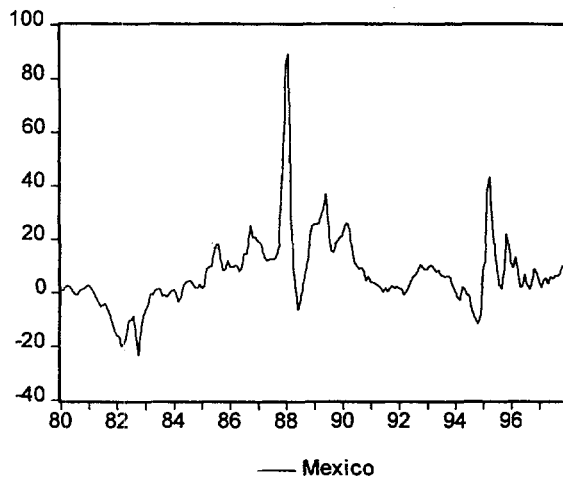


Figure 5: *Real Ex-ante Interest Rates* (contd.)

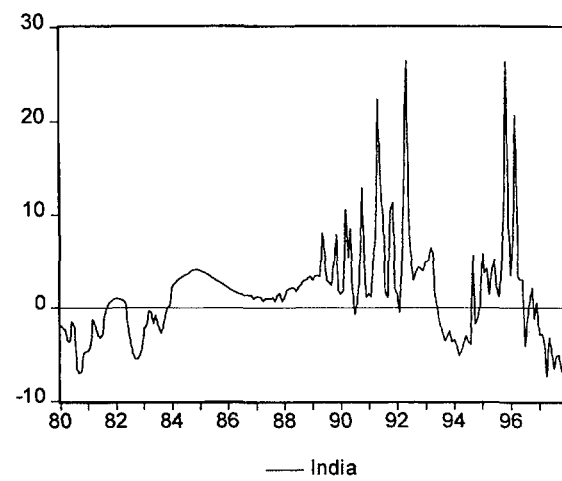
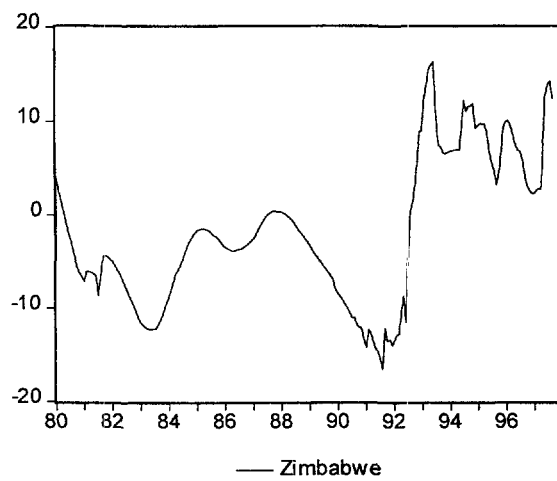
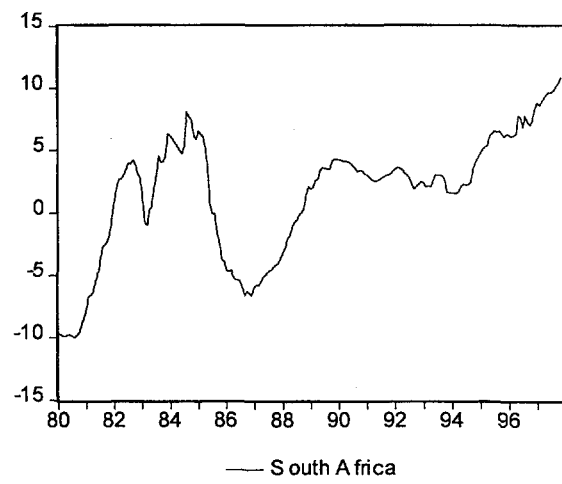
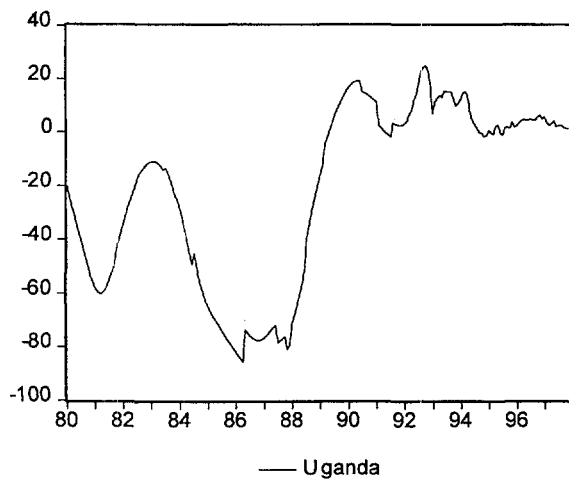
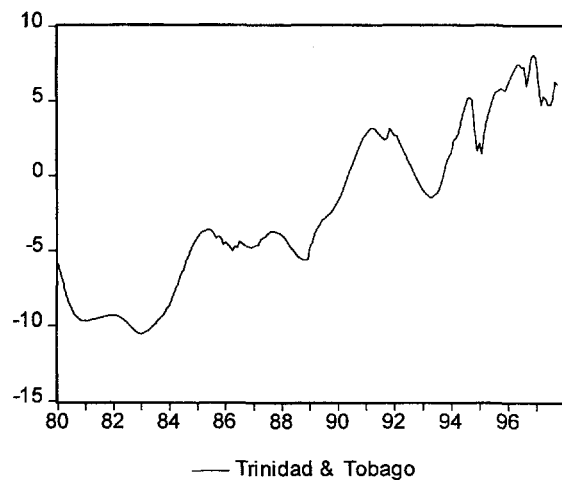
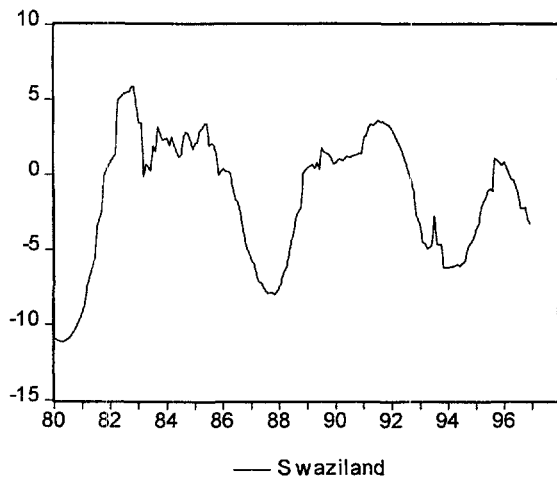
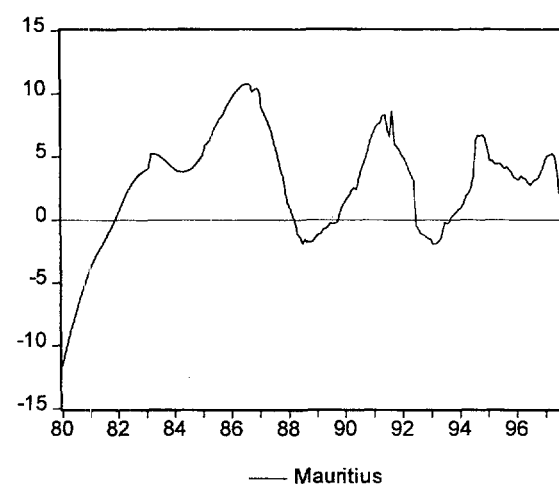
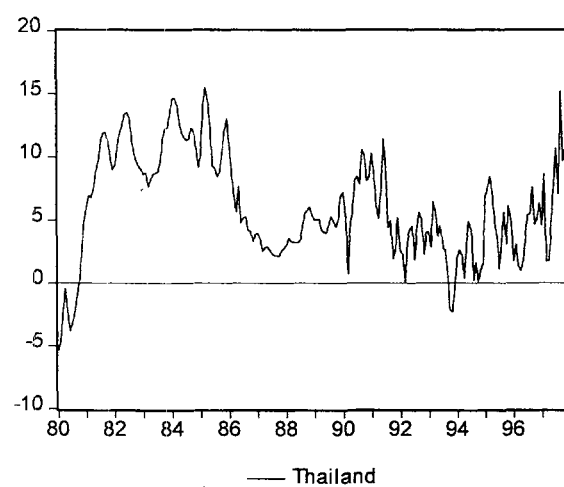
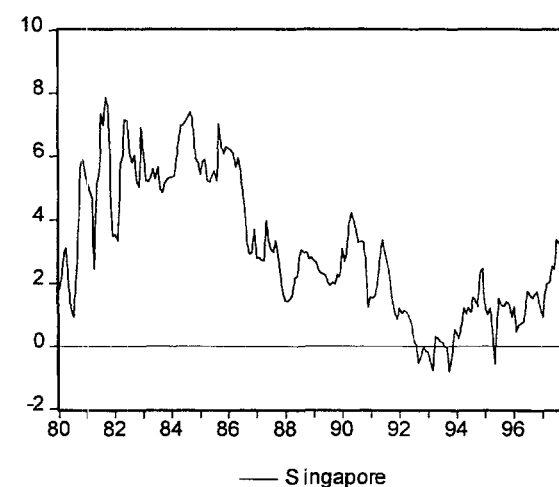
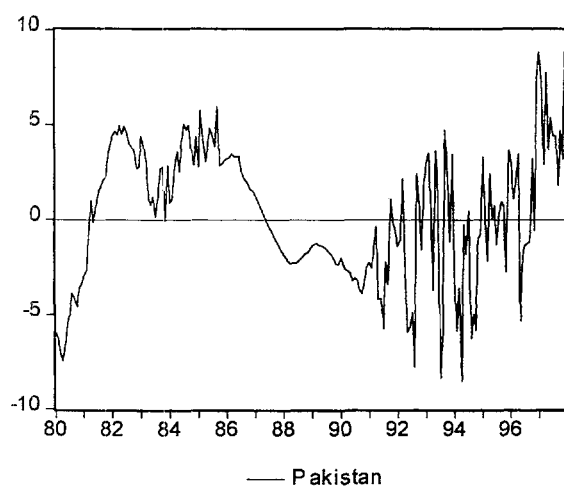
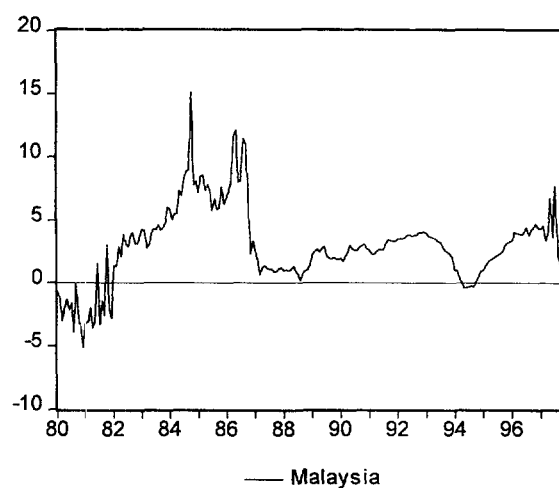
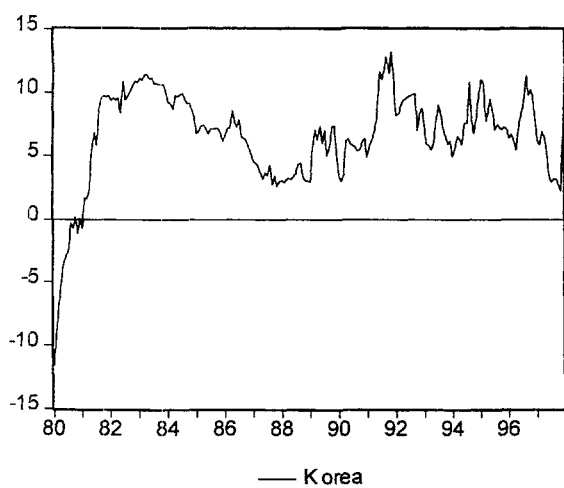
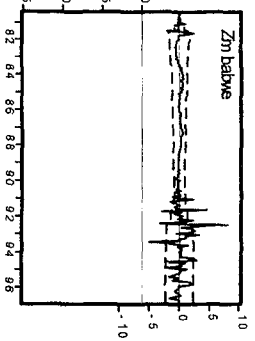
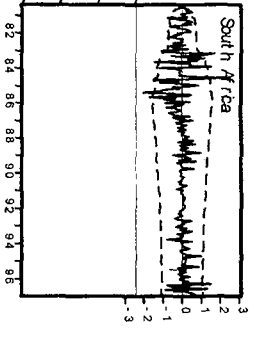
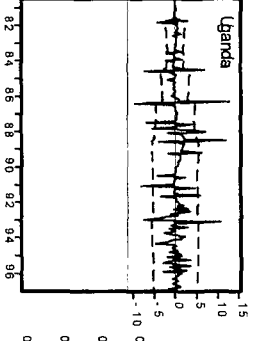
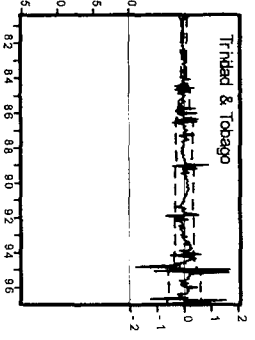
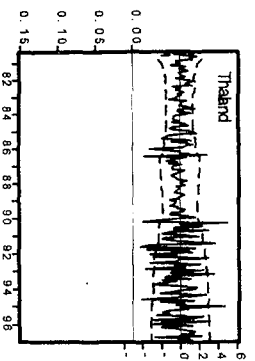
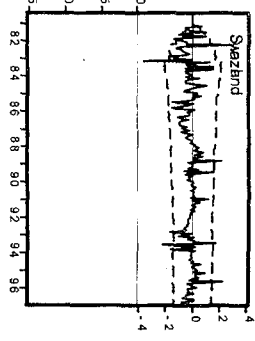
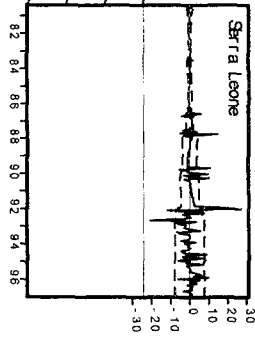
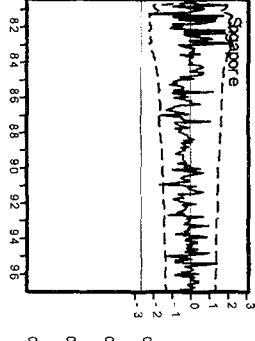
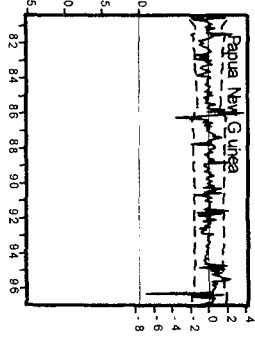
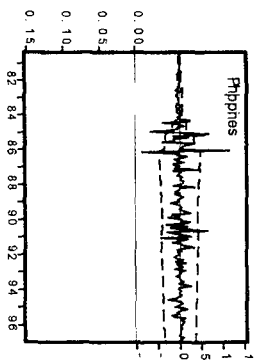
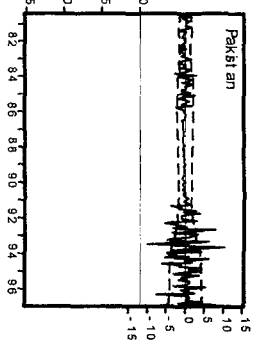
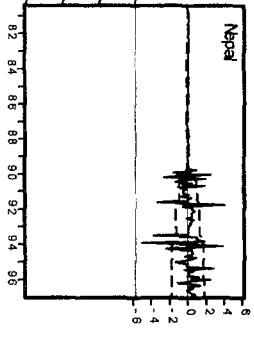
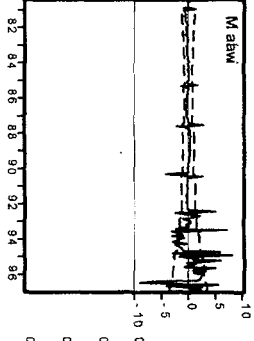
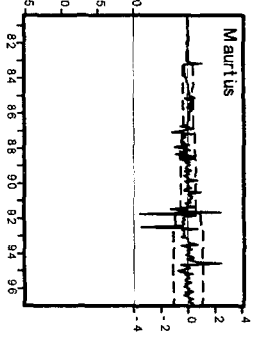
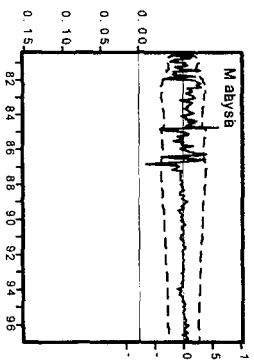
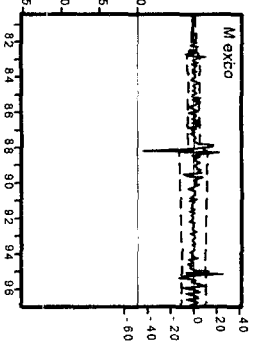
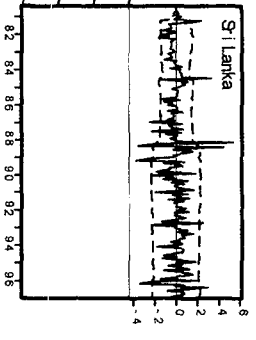
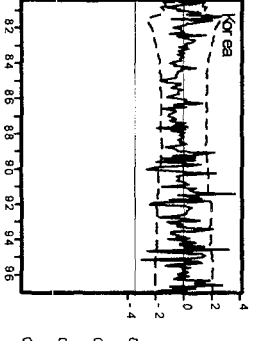
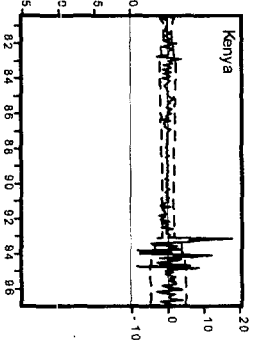
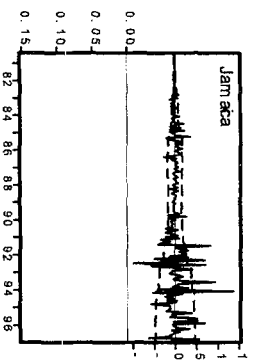
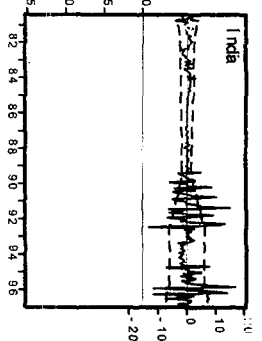
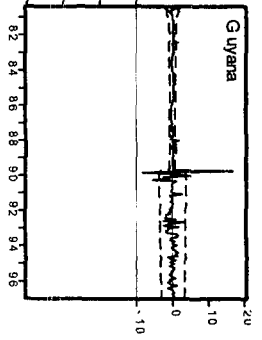
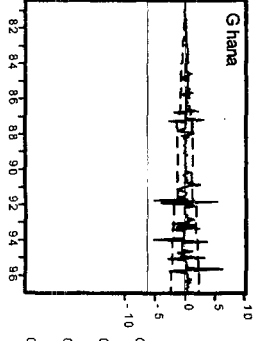
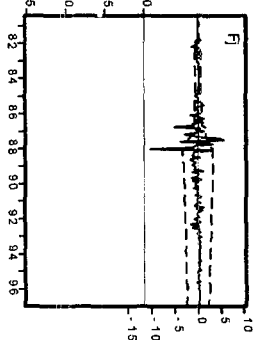
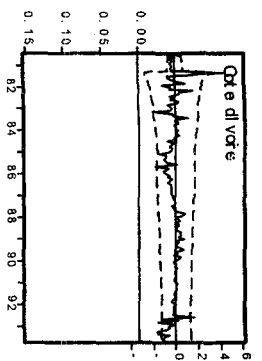


Figure 5: *Real Ex-ante Interest Rates* (contd.)





Data Appendix

The interest rates data used is from *International Financial Statistics*. Five interest rate categories are used: Official rates (60) represent rates at which the central banks lend to financial institutions. Money market rates (60B) – representing interbank lending – and treasury bill rates (60C) are the two wholesale rates, while bank deposit (60L) and lending (60P) rates are described as retail rates, though the data collected does typically refer to rather large transactions. IFS also contains some long-term government bond interest rates which we have not examined in this paper.

Up to the mid-1970s interest rate data other than official rates was only available for a handful of countries. Country coverage of the interest rate series in *IFS* improved rapidly in the late 1970s so that from 1980 on fairly comprehensive coverage exists for the wholesale interest rates of over 50 countries, and the official and retail rates for over 70 countries.

For the monthly time series analysis of wholesale rates, we confined our analysis to countries for which complete or nearly³⁴ complete data was available over the period 1980-97. Treasury bill rates (60C) are available for some 40 countries, of which 27 developing countries.³⁵ As it happens, 5 of these countries are all tiny members of the East Caribbean Currency Board (ECCB), with a common interest rate and exchange rate policy. A further five have populations of under 0.5 million. Therefore most of our analysis concentrates on the remaining 17 larger developing countries, together with one representative for the ECCB. In addition we find a further 17 developing countries for which substantially complete monthly data on money market rates (60B) is available, of which seven share a common rate in the West African Monetary Union. Excluding all but one of the latter, this gives a total of 28 developing countries for which complete data on the movements in wholesale rates can be analyzed. These countries are: Argentina, Brazil, Côte d'Ivoire, Fiji, Ghana, Guyana, India, Jamaica, Kenya, Korea, Malaysia, India, Sri Lanka, Mexico, Malawi, Mauritius, Nepal, Pakistan, Papua New Guinea, Philippines, St. Lucia, Sierra Leone, Singapore, Swaziland, Thailand, Trinidad and Tobago, Uganda, South Africa, Zimbabwe. Although a microstate, St. Lucia is included as a representative of the ECCB. Côte d'Ivoire represents the UMOA. The following 12 industrial countries, for which monthly data on 60C exist, were included as controls: Australia, Belgium, Canada, Germany, Ireland, Italy, New Zealand, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

For the expected or *ex ante* real interest rates, a Hodrick-Prescott filter with parameter 1600 was applied to the log-change in each country's CPI, and the result subtracted from the nominal exchange rate (cf. Edison, 199[6]).

³⁴ In a few cases short stretches of missing data were filled by interpolating available quarterly figures, or by using regression relationships with available data.

³⁵ i.e. excluding those who were members of the OECD throughout. In this definition Korea and Mexico are included with the developing countries, as they were not members of the OECD for most of the sample.

For the econometric analysis using quarterly data on deposit and lending rates, similar sample selection criteria were applied (substantially complete availability of the relevant data over 1980-97; no microstates, only one country per currency union). This left 37 developing countries for which more or less complete quarterly data on the movements in bank rates can be analyzed. These countries are: Argentina, Botswana, Brazil, Cameroon, Costa Rica, Côte d'Ivoire, Cyprus, Fiji, the Gambia, Ghana, Guatemala, Guyana, Honduras, Indonesia, Jamaica, Korea, Malawi, Malta, Mauritius, Mexico, Morocco, Nigeria, Papua New Guinea, Philippines, Rwanda, St. Lucia, Sierra Leone, Singapore, South Africa, Sri Lanka, Swaziland, Trinidad and Tobago, Turkey, Uganda, Uruguay, Zambia, Zimbabwe. For Ghana, Mexico and Turkey, deposit rate only was used. Argentina and Brazil were excluded from the econometrics because of their outliers. For analysis requiring both wholesale and bank rates (Table 5) the following countries also had to be excluded for want of data: Botswana, Cameroon, Costa Rica, Cyprus, the Gambia, Guatemala, Honduras, Malta, Nigeria, Rwanda, Uruguay. That left 21 countries in the standard sample used. Data for 19 industrial countries were used as controls: Australia, Belgium, Canada, Denmark, Finland, Germany, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

The shortcomings of the data must be acknowledged. Long series like the ones we are using necessarily involve changing definitions of the underlying assets, as institutions and data-collection methods evolve. Furthermore, there is typically a very wide range of interest rates prevalent in any financial market, depending on size, creditworthiness, maturity and other asset characteristics. The limited number of series available here will capture this diversity very imperfectly.

Appendix 1: Using economic theory to assess wholesale interest rate liberalization

Interest rates that are administratively controlled may differ both in their average level, their volatility and in their correlation with movements in market-determined interest rates. Analysis of these characteristics of interest rates can help characterize the extent and nature of the interest rate controls. It can also help distinguish between countries that have biting controls, and those that do not.

Economic theory gives some pointers as to the likely influences on, and correlates of, uncontrolled interest rates. For example, if there is a stable demand for money function, then interest rates will be correlated with the money stock and the other determinants of money demand. For instance, if the demand for money function is,

$$m_t^d - p_t = a_0 + a_1 i_t + a_2 y_t + a_3 (m_{t-1} - p_t) + u_t, \quad 1$$

then the money market equilibrium condition can be solved for the interest rate i to obtain:

$$i_t = i_t^0 \equiv \frac{1}{a_1} [m_t - a_3 m_{t-1} - (1 - a_3) p_t - a_0 - a_2 y_t - u_t]. \quad 2$$

A stable demand for money should mean that the parameters a_i are constant over a relevant period and a moderate variance of the disturbance u . More complicated money demand specifications may be required (including different dynamic specifications), but the general idea of a stable relationship between the interest rate, money and the determinants of its demand remain. Note that these relationships should hold if domestic money markets are uncontrolled; they do not require liberalization of the external capital account.

Another theory-derived relationship for market-determined interest rates is uncovered interest parity (UIP). This relates domestic to foreign interest rates by the expected rate of exchange rate change plus a possible risk premium:

$$i_t = i_t^* \equiv i_t^f + E_t s_{t+1} - s_t + \xi_t \quad 3$$

Evidently (3) can only be expected to prevail if there are no effective exchange controls. The two equations (2) and (3) thus define two shadow interest rates: i^* being the interest rate that would prevail under UIP, and i^0 being the rate consistent with internal money equilibrium.

The volatility of the two shadow rates depends on the volatility of the determinants and their mutual correlation. If short-run output changes and stochastic shocks to the money demand equation are small, or are negatively correlated with change in the real money stock (accommodating monetary policy), then the variance of the change in i^0 will be relatively low. If expected exchange rate change and the risk premium demanded by speculators are volatile and mutually uncorrelated, then i^* will be relatively volatile. This plausible ranking is used in approach (b) of the text to dating liberalization of wholesale rates.

Of course, the two shadow rate equations are not incompatible. Some or all of the other variables shown may be endogenous. If both UIP and domestic monetary equilibrium (with the money demand function adopted) prevail, then the two shadow interest rates will be equal. Thus, for example, in a fixed exchange rate regime, the money stock may adjust to ensure that the money market equilibrium condition (2) prevails, with $i_t^0 = i_t^*$.

Previous literature: major contributions to measuring liberalization

Two main approaches in the literature draw on this equilibrium framework to assess the degree of capital account openness. The first, due to Edwards (1985) and Edwards and Khan (1985), defines an open capital accounts as one which satisfies UIP. This approach nests the UIP in a broader maintained hypothesis encompassing both the domestic monetary equilibrium and UIP conditions as special cases. For example, we can estimate³⁶ the parameter ϕ in a regression defined by:

$$i_t = \phi i_t^* + (1 - \phi) i_t^0 + \varepsilon_t \quad (4)$$

The value $\phi = 1$ is interpreted as complete capital mobility, $\phi = 0$ as a closed financial system.

The Edwards-Khan approach requires the use of data on interest rates. However, such data may not be available, at least for some of the relevant domestic financial markets. For example, published official interest rates may be applicable only to a fraction of borrowings and allocated by administrative directive. If there is a parallel market, then the unobserved interest rate on that market may give a better indication of the degree to which the financial system is integrated in the World economy. In order to deal with the unobserved interest rate issue, Haque and Montiel (1991) proposed a way of solving for the unobserved shadow interest rate that would prevail in the absence of capital mobility.

In contrast to Edwards and Khan, who use the shadow rate i^0 defined as the rate that clears the money market for the observed money stock, Haque and Montiel use the concept of the hypothetical money stock m'' that would prevail if there were no capital flows. They then define a new shadow rate i' as the rate that would clear the money market for the hypothetical money stock. Specifically, let m_t in equation (2) be replaced with m_t'' defined by:

$$m_t'' = m_t + k_t^p + v_t \equiv m_t' + v_t \quad (5)$$

where k_t^p is the net private capital flow, and v_t is a measurement error. The new shadow interest rate is then defined by:

$$i_t' \equiv \frac{1}{a_1} [m_t'' - a_3 m_{t-1} - (1 - a_3) p_t - a_0 - a_2 y_t - u_t'] \quad (2')$$

The true (but unobserved) interest rate i_t is now hypothesized to be a weighted average of the UIP and the hypothetical closed-market shadow interest rate i' giving:

³⁶ Provided we have some empirical substitute for the unobserved exchange rate expectation.

$$i_t = \phi i_t^* + (1 - \phi)i_t' + \varepsilon_t. \quad (4')$$

The money market equilibrium condition, evaluated at this (unobserved) interest rate i_t , then provides the regression equation to be estimated:

$$m_t - p_t = \pi_0 + \pi_1 i_t^* + \pi_2 y_t + \pi_3 (m_{t-1} - p_t) + \pi_4 (m_t' - p_t) + w_t \quad (5)$$

where the parameters π_i satisfy $\pi_i = \alpha_i \phi$ for $i=1,2,3$; $\pi_4 = 1 - \phi$, and the disturbance w_t is:

$$w_t = u_t - u_t' + \pi_4 v_t + \varepsilon_t. \quad (6)$$

The estimate of π_4 is the key parameter here, as a value insignificantly different from zero corresponds to an estimate of ϕ insignificantly different from unity, and thus to non-rejection of the hypothesis of perfect capital mobility.

While both EK and HM models estimate a constant parameter ϕ , it would easily be possible to adapt their approach to allow some time variation in ϕ , and hence in principle to estimate the timing of liberalization.

Difficulties

- (i) Recasting the Edwards-Khan approach to recognize that UIP and monetary equilibrium are not incompatible:

These two approaches present some issues of interpretation. To begin with the Edwards and Khan approach, there is the problem of interpreting values of ϕ that are insignificantly different from both zero and unity. A point estimate of ϕ lying between zero and one at first sight appears to imply a regime partially reflecting convergence to domestic money-market equilibrium,³⁷ and partly to UIP. But, as already noted, there is no logical incompatibility between these two hypotheses. Under the joint hypothesis H_1 of perfect capital mobility and money market equilibrium, if both i_t^* and i_t^0 are known they will be equal and hence perfectly correlated. Even recognizing that neither is known exactly, multicollinearity can be expected in the estimating equation if UIP truly prevails, preventing significant coefficients. Besides, under H_1 either of the proxies could be as good as the other for either of i_t^* and i_t^0 . In short, to find ϕ significantly different from zero is not consistent with H_1 , and it is not entirely clear how such a finding is to be interpreted. We return to some ways out of this difficulty in (v) below.

- (ii) Does the Haque-Montiel approach simply add measurement error to an identity?

The Haque and Montiel approach adds some additional difficulties of its own. First is the definition of m' . Simply subtracting actual private capital flows from the observed money stock certainly does not provide a reliable estimate of what the money stock would be if capital were totally restricted. Public capital flows and the current account are also likely to be endogenous. The measurement error v is likely to be significant, biasing the estimate of ϕ towards unity. More generally, one may be allowed to be skeptical of a hypothesis test that depends on the value of the coefficient of a variable that has been constructed by adding a novel variable to the dependent variable.

³⁷ Recall that the 'equilibrium' of equation (1) has a lagged adjustment built-in.

Indeed, inspection of Haque and Montiel's 15 country regressions reveal that only three of the countries have estimated money demand functions with a significant interest rate variable. The estimated equations are consistent with what one would expect if k^p , i^* and y were just uncorrelated noise, and the postulated monetary equilibrium and UIP were not true. In effect, what is being estimated is a noisy identity. In particular note that for India, where k^p has low variance, the estimated coefficient π_4 is insignificantly different from unity, and all the other variables insignificantly different from zero.

(iii) What does the variable m_t'' measure?

One may also question the theoretical basis for constructing the weighted average interest rate using (2'), based on money market equilibrium computed at hypothetical money stock m_t'' instead of (2), based on the actual money stock m_t . For suppose that $\phi = 0$ is true. Then the HM model asserts that (2') prevails. But the actual money stock is m_t , not m_t'' . So the postulated relationship (2') actually implies monetary disequilibrium (since in general $m_t'' \neq m_t$). As such, the KM model is not consistent with domestic money-market equilibrium.

Note that, if we try to modify HM's approach by simply substituting (2) for (2') we cannot proceed to recover the parameter ϕ , which is no longer identified in the new estimating equation (5'):

$$m_t - p_t = \alpha_0 + \alpha_1 i_t^* + \alpha_2 y_t + \alpha_3 (m_{t-1} - p_t) + w_t \quad (5')$$

The only leverage one has here is that (5') is derived under the condition $\phi \neq 0$. A finding that the coefficient of i^* in (5') was non-zero would thus be a test against complete closure of the capital market.

(iv) UIP doesn't fit well for most countries

Finally there is a broader problem with both of these approaches, and that is that, although well-founded theoretically, UIP and a stable money demand function are both conditions for which there is comparatively little empirical support even for industrial countries with open capital accounts. Indeed, UIP is generally rejected in empirical studies.³⁸ Demand for money functions often shift, and need to be quite complex to have a chance of remaining stable over lengthy periods. Therefore, however solid the theoretical basis of these tests for capital integration, they rest on rather flimsy empirical underpinnings.

There are possible explanations which allow us to believe in UIP even though it fails most stringent tests. McCallum (1994) proposes that if UIP is augmented with a disturbance term, and if that error should be correlated with the interest differential (as it would if policymakers responded to the disturbance by liquidity policy) then one would observe failure of the usual UIP tests. Kaminsky (1993) suggests that UIP fails in small

³⁸ Though it may pass weak tests, such as stationarity and non-zero mean of deviations from UIP (Tanner, 1998).

samples because of a peso problem: agents are not sure which regime they are in and hedge their behavior in a way that becomes a systematic forecasting error over intervals of several quarters or more. Mishkin (1992) observes that the Fisher equation (a domestic economy equivalent of interest parity) is more closely satisfied in periods of rapid inflation. This might also be relevant for UIP.

(v) Decomposition of UIP deviations

The underlying idea behind the Edwards-Khan approach is to try to detect the extent to which domestic factors cause a deviation from UIP. The issue we have identified in (ii) above is that EK's regressions imply that *any* correlation between interest rate and domestic variables is seen as a deviation from UIP even though some of such correlations are consistent with UIP.

A theoretically more robust way of drawing inferences from correlations between domestic variables and interest rates (within a UIP context) is to recognize that such correlations can exist, but must enter through the interest parity condition. Specifically, if we assume that a linear combination of domestic variables X_t observed at time t , helps forecast future exchange rates, and that rational expectations prevails, then we can write:

$$s_{t+1} - s_t = X_t \beta + u'_t \quad (7)$$

where u'_t is uncorrelated with X_t . Now if UIP prevails, we can take expectations in (7) and substitute into (3) to obtain:

$$i_t = i_t^* \equiv i_t^f + X_t \beta + \xi_t \quad (3')$$

Now (3') and (7) can be jointly estimated and the restriction of equality of the parameters β in each can be tested. That should provide a more robust test of the open capital market hypothesis. However, for this we do (of course) require the maintained hypothesis that the risk premium ξ_t is also uncorrelated with X_t .

(We did implement the above approach for both industrial and developing countries. Writing the forecast of exchange rate change ($s_{t+1} - s_t$) from (7) as z_t we estimated the equation:

$$i_t = \alpha(i_t^f + z_t) + X_t \beta' + \xi_t$$

and found that β' is always significantly different from zero. Interestingly, α , which could be thought of as an index of the degree to which UIP prevails, is insignificant for pre-liberalization periods in the developing countries, but estimated at 0.37 (with a t-statistic of 10.5) for post-liberalization periods. Note, however, that α is estimated as insignificant for industrial countries, recalling the empirical weakness of UIP for those countries.)

Several recent papers employ an equation similar to (7) to probe the correlates of deviations from UIP. One useful and popular approach involves decomposition deviations from UIP (forward bias) into changes in real exchange rates and real interest differentials. Levine (1991) provides evidence to show that anticipated real exchange rate

changes pass through to UIP deviations one-for-one and that these (rather than deviations in expected real interest rates) are the primary component of the forward bias (for five industrial countries). This conclusion meshes well with the well-known fact (for these countries) that short-run nominal exchange rate changes are much more volatile than nominal interest or inflation rates: thus short-run fluctuations in real exchange rates are dominated by nominal exchange rate changes.

Tanner (1998) applies a similar decomposition to a larger sample, including developing countries, but assesses the relative importance of the different components mainly by comparing the size their variances. His finding that real interest rate variations are relatively important in developing countries is thus chiefly a reflection of that importance of inflation fluctuations in many of the developing countries that are in his sample.

The findings of Levine and Tanner are not incompatible. With his regression approach, Levine is essentially stating that it is only to the extent that real exchange rate changes can be forecast that UIP deviations can be forecast: in explaining UIP deviations it does not help to add variables additional to the forecast real exchange rate change. Tanner's result is not concerned with forecastability: he merely ranks the contribution of variances and covariances. His point that real interest rates are highly variable in developing countries does not imply that their changes are forecastable. (Though they are, as we show in the text).

In fact, applying Levine's general approach to our developing country data, we find that the best forecast of real exchange rate change (linear projection on available macro data) does help forecast UIP deviations, but that it can be improved upon by the separate inclusion of some of the other explanatory macro variables.

(vi) Alternatives to UIP

Other equilibrium relationships could conceivably be used in lieu of UIP as a benchmark for testing for liberalization of wholesale rates. Among possible candidates might be the theory of correlation between deviations from purchasing-power parity and real interest differentials, at least at business cycle frequencies (Baxter, 1994, Levine, 1992; but see Edison and Pauls, 1993).³⁹ However, it is probably fair to say that these are not much more empirically robust than UIP.

More generally one can model the response of interest rates to inflation (Fisher effect), exchange rate change and foreign real rates. Relevant here is the hypothesis of constant expected real interest rate *differentials* (cf. Cumby and Obstfeld, 1984, Levine, 1991). The speed of convergence of real interest rates towards a world norm can be measured (Faruquee, 1991, Cavaglia, 1992, cf. O'Connell, 1998). A version of this approach is presented in the paper.

(vii) Statistical multi-factor models

³⁹ Could also compare other models of interest rate determination (e.g. Orr, Edey and Kennedy, 1995).

Since there are so many unobserved variables and the theoretical determination of interest rates is so complex, it may be useful to approach the question of modeling the entire set of world interest rates as being determined by a small number of unobserved common factors plus idiosyncratic local factors. This approach has been employed, for example, by Koedijk and Kool (1994), in order to analyze European interest rates, and the method is potentially even more effective when data on a larger number of countries is available.⁴⁰ It can allow both identification of a core world interest rate for comparative purposes (measure mean deviation in real rates), and also allow the experience of different developing countries to be grouped. The interesting issues include: (a) How many significant common factors are there in real interest rates across the world? (b) What are the characteristics of countries have low correlations with the main common factors? In particular, what is the role of financial repression; and of national inflation volatility in determining low correlations.

In practice, we find that on the larger sample of 24 developing country wholesale rates⁴¹ the picture that emerges is of a diverse and volatile interest rate experience, with considerable persistence in real interest rate movements. The degree to which the movements are common across countries was assessed by computing the eigenvalues and principal components of the real interest rate data. With the first principal component accounting for only some 28 per cent of the total variance it is clear that the degree of commonality is rather modest. Indeed, a three-factor model explains only 61 per cent of the total variance, and a six factor model is required to reach 80 per cent). With such modest explanatory power, it is not surprising that no evident economic interpretation could be placed on these principal components, nor are they highly correlated with industrial country interest rates.

A technical difficulty that emerges in using factor models is that high volatility countries tend to dominate the overall variability to be explained, and a natural normalization of the data that would reduce this dependency on outliers is not obviously available.

⁴⁰ The model of unobserved common factors has also been applied to the term structure of interest rates in one country; see for example, Jegadeesh and Pennacchi (1996).

⁴¹ This is the monthly sample (excluding Argentina and Brazil) discussed in the text.

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